THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 28. Thursday, October 18, 1923. No. 374.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Contents.

	PAGE
The Analysis of Cast Iron	323
"Moulders" of the Industry—No. 18	324
The Importance of Manganese Steel	324
The Use of Cast Alloys for the Working Parts of Machinery	325
Alloy Steels at High Temperature	329
Templeton Silica Brickworks	330
Designing and Equipping a Foundry Laboratory	334
Economics and Psychology in Industry	337
Institute of British Foundrymen	338
Book Review	340
Foundry Work in South Africa	341
Book Reviews	341
New Catalogues, etc.	342
Correspondence	342
Iron and Steel Output in September	342
French Iron and Steel Output in August	342
Trade Talk	342
Iron and Steel Markets	343
Company News	344
Personal	344
Gazette	344
Open Contracts	344

Forthcoming Events.

OCTOBER 19.

Staffordshire Iron and Steel Institute:—First ordinary meeting at Dudley. Presidential address by F. J. Cook.

OCTOBER 22.

Institution of Mechanical Engineers (Graduate Section):—Ordinary meeting in London. "Four-wheeled Brakes for British Light Cars." Paper by J. Harrison.

OCTOBER 26.

The Manchester Association of Engineers:—Afternoon visit to the works of Crossley Motors, Limited, and A. V. Roe & Company, Limited, Manchester. "Aeroplane Design," Paper by Roy Chadwick, R.A.S.

OCTOBER 27.

West Yorkshire Metallurgical Society:—General meeting at Bradford. "Some Physical and Chemical Properties of Refractory Materials," Paper by H. S. Houldsworth, M.Sc.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1923-24, Oliver Stubbs, M.I.Mech.E., Openshaw, Manchester.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.
Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.
Scottish: W. H. Bound, 69, Minard Road, Shawlands, Glasgow.
London: H. G. Sommerfield, Woodhouse Road, N.12.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: J. M. Meston, 37, Melville Road.
West Ridings of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

[Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

The Analysis of Cast Iron.

Mr. H. J. Young has on many occasions thrown doubt on the accuracy of published figures giving the composition of cast iron. This is not, we believe, meant to cast an aspersion on the ability of the average foundry chemist, but rather to emphasise the difficulties which exist both in sampling and analysing the material. We are forced to the conclusion, considered from the national point of view, that the present position is that the analysis of steel, especially special steel, is of a high standard, pig-irons much lower, and iron ores and cast iron distinctly bad. If our generalisations are accepted, it is essential that these conditions must be improved, and it is for the Cast Iron Research Association to investigate the matter. There is, we believe, at the moment only one national chemically standardised sample of cast iron available, at a laboratory in Middlesbrough. This and other samples should be prepared and analysed by a dozen or more establishments; small bars, not drillings, should be available at cost price for every chemist in the country, and should be "run through" every time a batch of cast iron has to be analysed. This implies that any laboratory finding a consistent deviation from standard in the results obtained will either utilise a correction factor or preferably change or modify the methods employed until the standard invariably gives results concordant with the composition nationally agreed upon.

Until this has been established it is possible for any critic of any technical paper or report to nullify any conclusions by the observation that the analysis of cast iron being in such a chaotic condition the results are useless, *as they may be incorrect*. Obviously such a position is intolerable.

The question of the provision of suitable standards is difficult. It is obvious that cupola-melted material is too variable. As a large quantity of material or a standard composition is essential, we suggest that washing charges made by the large open-hearth furnaces for the purpose of "setting" a newly-constructed hearth should be used, the material being cast into the smallest clean chills available. After ascertaining the extent of the segregation, the portions of which are free from this should be cut up into small bars. If the proportion of combined carbon is found to be unstable, then perhaps the small bars could be heat-treated to render them comparable. We anticipate considerable difficulty with this element, but if the other four elements, the silicon, manganese, sulphur and phosphorus, were standardised, it would be of undoubted help.

We are aware that some works possess a fair quantity of chemically standardised samples of cast iron, and if they could be induced to have these checked by several independent workers in order to obtain general acceptation and to sell the drillings to the smaller foundries, they would be doing a national service. A previous reference was made to the advisability of supplying bars in place of drillings; this is due to the fact that the graphite in the drillings becomes unevenly distributed throughout the sample owing to the unavoidable shaking and vibration during transit.

It is not pleasant to have to admit that this relatively simple matter of procuring a reliable analysis of cast iron exists, but all we ask our readers to do is to send the same sample of cast iron to half-a-dozen foundry laboratories and compare the results.

"Moulders" of the Industry.—No. 18.

Sir Robert Hadfield, Bart., F.R.S.

It is a curious fact that though Sir Robert Hadfield is Britain's premier steel foundryman, he is more usually thought of as a savant in the metallurgy of special steels, which one quite often, though erroneously, associates with ingot practice. However, *manganese steel* (his invention) *is a foundry product*, and British foundrymen early recognised Sir Robert as an outstanding personality in the foundry world by making him the first honorary member of the British Foundrymen's Association, now the Institute of British Foundrymen. Though Sir Robert has attained equal eminence in other branches of metallurgy, it is the intention in this article to emphasise his contribution to foundry practice, and ony to refer in passing to allied, though equally important, discoveries.

Photo by] [*Swaine.*

Sir Robert Hadfield, Bart., F.R.S.

Sir Robert was born in Sheffield in 1859, and comes of an ancient Derbyshire yeoman stock. He was educated at the Sheffield Collegiate School. At the age of 16 Sir Robert started his business career, and was early attached to the laboratory in his father's works. After some six or seven years of works' practice (1882), he invented manganese steel. No useful purpose would be served by recounting to the cast-iron foundryman the special properties to be associated with manganese steel. He is only too well aware that when he is unable to meet a specification with chilled iron for crusher jaws, dredger buckets, and other castings which have to be specially hard and tough, he consoles himself with the remark that there is nothing left but to use manganese steel. The opinion of the mechanical engineering world on the subject of manganese steel is crystallised by the remarks of Sir Henry Fowler, K.B.E., the chief mechanical engineer, in an address to the graduates of the Institute of Mechanical Engineers, who stated: "His (Sir Robert's) work on manganese steel really opened up a fresh era, and was, with the exception of Mushet's work, the first investigation into alloy steel. This steel is used wherever heavy wear has to be encountered, and its non-magnetic qualities are of great advantage under certain conditions."

Though not a true foundry product, the high-silicon, low-hysteresis steel is of equal, if not of greater, importance than manganese steel. This, too, was Sir Robert's invention, and as a result, the modern motor-car and aeroplane have been made possible; thus the enormous number of castings made every week for these industries are indirectly attributable to his invention, and for which the foundryman has to thank Sir Robert.

In 1888, Sir Robert was appointed chairman and managing director of Messrs. Hadfields, Ltd., and in 1891 he introduced the 48-hour week, when 52 hours was the standard time. He was made a Justice of the Peace for Sheffield in 1896, and in 1899 was appointed to the position of Master Cutler of Sheffield. This is one of the oldest and most important corporate bodies of Great Britain, and it is interesting to note that one of his ancestors held this position in 1828. Sir Robert was President of the Iron and Steel Institute from 1905 to 1907, and from this time honours were thickly showered upon him. In 1908 he was created knight, and in 1909 was elected a Fellow of the Royal Society—the highest honour pure science can bestow. During the next few years he was awarded the degree of Doctor of Metallurgy and Doctor of Science by the Universities of Sheffield and Leeds.

The Faraday Society were fortunate in having Sir Robert as their President from 1914 to 1920. He was made a Freeman of the City of London in 1917, and later that year was created a Baronet.

Sir Robert is a member of numerous scientific societies to whose proceedings he has contributed largely. For his research work he has been awarded the Telford Gold Medal; George Stevenson Gold Medal; the Howard Quinquennial Medal; the Bessemer Gold Medal; James Forrest Premium; Electrical Engineers' Premium; John Watt Medal; Thomas Turner Gold Medal; John Scott Gold Medal; Elliott-Cresson Gold Medal; and the John Fritz Gold Medal. In addition to these there are four other medals given by French Associations.

The Institute of British Foundrymen are very deeply indebted to Sir Robert for the practical help he gave them by co-operating so heartily in entertaining their recent guests—the American Foundrymen's Association.

The Importance of Manganese Steel.*

By Sir Robert Hadfield, Bart., F.R.S.

Probably not many of those who ride in the tramcars of our large cities realise that, but for the use of manganese steel in the tracks, such efficient tramway services would be quite unworkable, no other steel being able to withstand the very severe wear and tear at the more congested portions where traffic converges in modern trackways. The introduction of manganese steel for trackwork in its present state of perfection was, of course, not accomplished without a great deal of experimental work and profiting by experience gained in its use.

Again, in the machinery employed in the crushing of road metal for highways, manganese steel is used to form the jaws between which the material is crushed. No other material is able to give such excellent service owing to its extraordinary resistance to wear and abrasion; the greater the severity of the crushing action, the better the manganese steel wears. The machinery for crushing the hard quartz rock in which the ore is found in gold mining also requires the use of manganese steel in a similar way.

These are examples of the many uses of manganese steel, among which may also be mentioned the wearing parts of excavating machinery, dredger buckets, and other portions of dredgers subject to excessive working action.

The non-magnetic character of manganese steel has also been made use of in various ways, more especially in its use for steel structures near the compasses on warships. To construct such parts of any other steel than manganese steel would be to destroy the action of the compass, due to the superior magnetic attraction of the steel entirely masking the directive force of the earth's magnetic poles on which it relies.

* Extracted from Pamphlet No. 3 of the British Science Guild Publicity Service.

The Use of Cast Alloys for the Working Parts of Machinery.*

By Mons. Pisek, President of Czecho-Slovakian Foundrymen's Association.

When a machine is working, its members are subjected to various stresses. The technical properties of the materials decide for which parts they will be employed. A machine is so designed that the complicated, impressed forces are converted into simple applications, such as traction, compression, bending, etc. Materials possessing suitable properties, to resist the particular stresses imposed, must be selected for the several parts of the machine. Each part of the machine should satisfy the following requirements:—(1) It must stand up to the stresses imposed by its duty; (2) it must be of simple design; (3) wear must be reduced to a minimum; and (4) cheapness of manufacture is important. Certain special properties may be required—resistance to acids, resistance to heat, hardness, etc. Resistance to various destructive forces is indicated by the results of tensile, compression and transverse tests; these tests are carried to destruction, and the force which first produces a permanent change in shape indicates the malleability of the material and, to a smaller extent, its ductility. If the magnitude of the force and the extent of deformation are considered together, an indication of the hardness of the material is arrived at. Hardness, then, is the resistance offered to penetration by another object. If the stress applied to the material under test ceases to act, three cases are possible:—(1) The deformation completely disappears; (2) the deformation partly disappears; and (3) the deformation is permanent. A consideration of these phases settles the question of elasticity. The more elastic a material is, the more quickly do its molecules return to their original position when the stress is removed. A metal is tenacious when its molecules adhere strongly to each other; it is then also highly resistant to shock.

The majority of machine parts are made as castings either of single metals or two or more metals alloyed; this is the cheapest method of making pieces of complicated form.

In the manufacture of castings, however, it is rarely possible to use a single metal, since very few of the metals have all the properties necessary to meet the various stresses to which the parts are subjected; used alone, the metal may be too soft, too weak, or too brittle. In order to impart the desired properties, it is usual to mix the two or more metals, and sometimes non-metals, so that the properties of each are modified and improved. The resulting alloys have all the properties which distinguish a metal. According to accepted definition, alloys are neither merely mechanical mixtures nor true chemical compounds, though in certain special cases compounds are formed.

Alloys differ from chemical compounds in that the proportions of the component metals are arbitrary and not in fixed ratios of their atomic weights. Alloys differ from mechanical mixtures in that the ingredients can only be separated by purely chemical processes; with the unaided eye it is impossible to distinguish the separate components. The properties of alloys differ completely from those of the metals composing them. The more the chemical properties of the metals differ, the better do they alloy and the more widely do the resultant properties differ from those of the constituents. Alloying provides the principal method for adapting the metals for use as castings of machine parts.

Alloys for such castings are prepared as follows: (1) The constituent metals are not pure, but are already alloys resulting from the contents of the ores and the metallurgical processes; in this case (*a*) the alloy is simply remelted, as, for instance, the iron in a foundry; (*b*) the alloy is remelted with the removal of a portion of the foreign substances, as in the manufacture of steel. (2) The constituent metals are pure, the alloys are then prepared (*a*) in the fluid state, (*b*) by dissolving a solid metal in a liquid metal, as sugar is dissolved in water. The resulting alloy is designated as binary, ternary or quaternary, according to whether it consists of two, three or four constituents. Alloys are always crystalline in structure and never amorphous. The physical properties of the alloys depend, in the first place, on their structure, that is, on the type of crystals of which they consist. Generally speaking, they may be classified as follows:— (1) Alloys possessing good physical properties consist of mixed crystals; (2) when chemical compounds exist the material is deficient in nearly all the desirable properties and is unsuitable for important castings. The formation of chemical compounds explains the difference in physical properties between alloys having almost the same composition. Equilibrium diagrams are of direct use to the founder because: They show in what proportions the two metals mix and how solidification proceeds; from evidence based on the diagram it is possible to determine the proportions of an alloy which, on solidification, will have a structure of mixed crystals, giving good physical properties; the equilibrium diagram for each composition of the two metals denotes the melting point, which is also the temperature to which the liquid alloy can be cooled before freezing; for a given temperature it is possible to fix the composition which will melt at that temperature; the eutectic mixtures, which freeze at a low temperature, are also the most fusible. Alloys which throw out mixed, or pure, crystals during solidification often pass through a pasty stage, in which pouring becomes difficult; alloys corresponding to chemical combinations are brittle and fragile; they can only be used for castings in special cases. Alloys which consist of pure or mixed crystals in a body of eutectic are liable to liquation; the longer the period of solidification, the greater is the danger of liquation. In the eutectic alloys there is no tendency to liquation. Alloys which undergo transformations in the solid state can have different structures, and consequently different properties; in such cases the structure depends on the rate of cooling.

Physical Properties of the Alloys.

The resistance of the pure metals to mechanical stresses is feeble. By the addition of another metal, or non-metal, that is, by making an alloy, the strength is increased in most cases; but the quantity of the added substance must not pass a certain limit, which varies according to the constituents. If this limit is exceeded, the strength of the alloy falls off very rapidly. A good example is furnished by bronze, an alloy of copper and tin. By the addition of tin to copper, the strength increases slowly up to a content of 18 per cent. tin, at which it attains a maximum. If further additions of tin are made, the strength of the alloy falls very quickly. The addition of a third metal to an alloy of two constituents gives a further increase of strength. An increase in the ultimate strength of a material is accompanied by an increase in the apparent elastic limit, and in the majority of cases this latter increase is greater than the former. One result of these unequal increases is that the metal loses ductility and tends to become brittle.

For the greater number of castings, considerable ductility is required as well as a high degree of strength: these conditions are met by alloys with a structure of mixed crystals and, in certain instances, by those of heterogeneous structure. Eutectic mixtures behave in a different manner. The combinations forming chemical compounds are characterised by high strength with great brittleness, the latter defect making them unsuitable for castings, except in rare instances. The strength of alloys of the same composition is not

* Translated and abstracted from a Paper presented to the Paris International Foundry Conference.

always equal; it varies according to the rate of cooling after solidification; this rate has a tremendous influence on the crystal forms of the grains. When cooling is slow, the crystals have time to develop—they grow. On the other hand, when cooling is rapid, development of the crystals is arrested, and they remain small. The fine structure of an alloy may be changed into a coarse structure by raising the alloy to a certain temperature, at which it is maintained for some time. Since the surface contact of the small crystals is greater than that of the large ones, it is easy to understand that an alloy of fine structure is stronger than one having a coarse structure.

Cooling Considerations.

When a casting is cooled normally in the sand, its strength depends on the area of the section and the thickness of the walls of the mould. The greater the thickness of the metal, the slower will the central portion cool and the larger will be the crystals, with a consequent decrease in the strength. This matter is very important when it is a question of taking test-pieces to determine the properties of the alloy. In order to make comparisons between tests of the same nature, it is necessary to take into account the size of the piece in the rough state before machining down to size. The common practice is to cast separately a piece whose section is equal to that of the greatest thickness of the casting. This, however, is not correct, since the conditions of cooling of a simple bar are quite different from those in the main casting. The best way would be to take the test-piece from the casting itself, but, in most cases, this is impossible.

Influence of Impurities and Overheating on Alloys.

The strength of alloys is largely influenced by the presence of foreign substances, by occluded gases, and by the temperature of pouring. For example, the presence of manganese and sulphur in iron increases its tensile strength, but the presence of silicon reduces this factor. Gas which has been absorbed also lowers the strength, a point which will be dealt with later. The temperature at which the alloy is cast has a very considerable influence on the strength. The structure shown in Fig. 1 is that of a brass with the following analysis:—Copper 60.02, zinc 38,67, lead 1.20, manganese 0.06 per cent., and nickel, iron and arsenic, traces. This alloy was overheated, having remained molten for two hours in the furnace; the structure showed needles of metal

Fig. 1.—Structure of a Brass Tap which has been Overheated in the Furnace for Hours.

which could be easily separated by a knife; the alloy was very brittle. After re-melting this material, the normal structure for brass was obtained. Fig. 2 shows the structure of steel from a converter; the composition was:—Carbon 0.18, manganese 0.54, silicon 0.23, phosphorus 0.27, and sulphur 0.097 per cent.; the material was overheated and cast. As a result of the overheating and of the very high phosphorus content, the structure showed very large crystals having the appearance exhibited by a fracture of spiegel; the material was so brittle that the riser could be snapped off with a single hammer blow.

Liquation.

Alloys which undergo transformation in the solid state may, by sudden cooling, be made to remain in an unstable condition at normal temperatures. In the majority of alloys, this quenching has the effect of increasing the strength, but the material also becomes brittle. The strength of an alloy is diminished when the component metals solidify in the order of their fusibility, a peculiarity known as liquation. In castings, liquation causes zones of different constitution. The composition, too, will vary at any section between the interior and the outer surface of the casting. Liquation depends on the solubility of the respective metals, their specific gravity, and the rate of cooling. The tendency to liquation

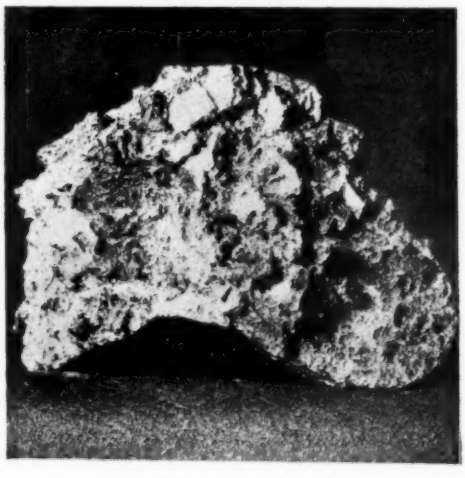


Fig. 2.—Structure of Steel Wheel, containing 0.27 Per Cent. Phosphorus.

is greatest when the metals are not miscible. The slower the rate of cooling, the more is the separation of the metals favoured according to their specific gravities. Alloys of metals which are miscible, and which solidify into mixed crystals, are less liable to liquation. If such an alloy is cast in a mould with very thick walls so that the cooling is slow, mixed crystals of a composition having the highest melting-point will first solidify against the faces of the mould.

In the centre of the casting there will be an alloy of lower melting-point, the composition of which will differ widely from that of the crystals forming the surface. Rapid cooling during solidification reduces liquation. Eutectic mixtures do not liquate. Since slow cooling encourages liquation, heavy castings are more susceptible to this defect than those of light section. It is well known that slow cooling of grey iron encourages the formation of graphite; this is really a separation of the carbon, and is an example of liquation. If the grey iron is rapidly cooled, the graphite does not separate; liquation has been prevented, and the result is white iron stronger, but also more brittle than the grey variety.

Physical Changes by Alloying.

The fracture of a round bronze bar which has been slowly cooled shows whiter at the centre than at the outer zones. The crystals at the centre are richer in tin than those at the surface. Some of the pure metals have the greatest ductility and malleability. By mixing two or more metals, the strength is increased, and at the same time the apparent elastic limit is lowered, that is, the metals lose ductility by alloying; consequently their brittleness is increased. Mixing two or more metals raises the hardness within limits, even when the added metal is softer than the primary metal. Alloys forming chemical compounds are exceptionally hard. Those alloys which undergo no transformations in the solid state are unaffected as to hardness by sudden cooling. On the other hand, the majority of polymorphous alloys, when heated above their change point, are hardened by rapid cooling. By quenching the trans-

formation is prevented, and the structure remains unaltered at normal temperatures. Steel furnishes a good example of this. In metals like bronze the crystals are softer in the metastable state than they are in the stable condition, and the metal is softened by quenching.

A highly important property for alloys is the ability to form good sound castings; this is dependent on the following factors, fusibility, fluidity and contraction. As a rule, alloys are more fusible than either of the component metals. Fusibility depends on chemical composition, temperature and the specific heat, or amount of heat

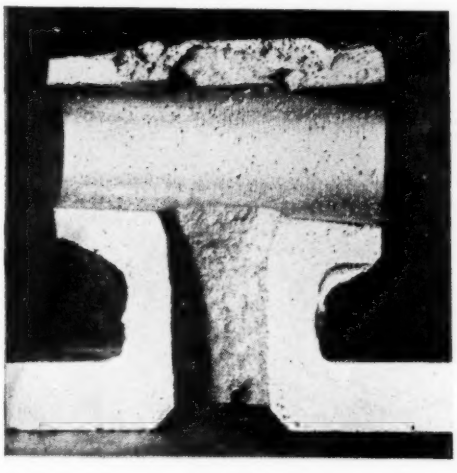


Fig. 3.—Porous Bronze Casting due to being Left in the Furnace during the Mid-day Break.

that must be employed to bring the metal to its melting point. This quantity of heat is not only a question of melting-point, but varies with each metal. As an example, aluminium, with a melting-point of only 657 deg. C., requires almost exactly as much heat to bring it to the molten state as does cast iron with a melting-point of 1,200 deg. C. The most fusible alloys are the eutectic mixtures and those in the neighbourhood of eutectic proportions.

In order to prepare an alloy, it is not always necessary to bring it up to the melting-point of the least fusible metal. To cast a difficultly fusible metal, it is only necessary to add it to a metal having a lower melting-point; it dissolves in the molten metal without the temperature being raised to its own melting-point. Fluidity is the property of flowing into the smallest cavities in the mould, and the higher the degree of fluidity, the easier is the metal to cast. As a rule, alloys are more fluid than their constituents, and frequently a very small addition of another metal will greatly increase the fluidity.

How Metals Solidify.

The solidification of an alloy does not take place instantaneously, but extends over a period more or less prolonged; crystals begin to separate from the liquid, the proportion of which grows progressively less until the whole mass is solid. If the proportion of crystals is large compared with the remaining liquid, the metal reaches a pasty stage; this pastiness hinders the escape of gas and renders casting difficult. Eutectic mixtures, which are the most fusible, have no pasty stage. If the metals or alloys are exposed, during fusion or when liquid, to the atmosphere or to gas, they are apt to absorb them, sometimes in large quantities; on occasions actual chemical compounds are formed. If an alloy is brought, when in the liquid state or during fusion, into contact with moist air, it decomposes the water, the hydrogen is absorbed by the liquid metal, and the oxygen of the air and of the water is also absorbed. If the metal oxidises with difficulty, the oxygen is retained, but in other cases it combines chemically with the metal, forming oxides. Since atmospheric air always contains water vapour, this difficulty is encountered whenever an air blast is necessary to obtain the high temperatures required for fusion. Owing to the reduced pressure in the furnace, part of the absorbed gas is liberated. This liberation of gas is increased during casting, when the molten metal comes in contact with the sides of the ladle and mould. As the temperature falls, it is possible to light a layer of gas which floats at the surface of the molten alloy. The capacity for absorbing gas increases as the temperature is raised; this is one reason for not pouring the metal too hot. When solid, the alloys cannot take up gas so readily as when liquid; the liberation of gas, therefore, is greatest during solidification.

Venting Moulds.

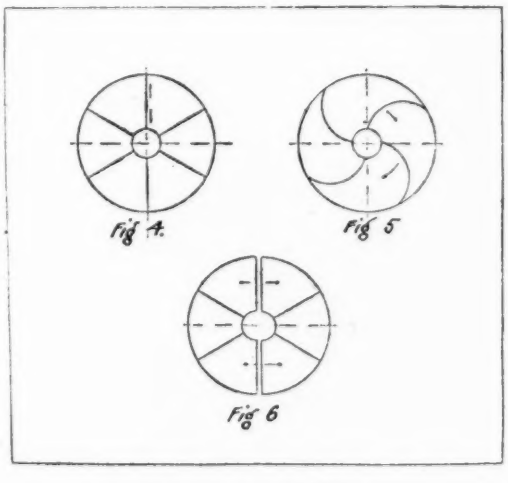
The moulder must devise his moulds to allow the free escape of the gas. A portion of the liberated gas escapes through the walls of the mould, which must be highly permeable. If the alloy has a pasty stage, free escape of the gas is hindered, and there is a danger of porous castings. The danger is greater when the constituent metals of the alloy are readily oxidised. Metallic oxides are then formed, which are soluble in the liquid metal; other reactions take place in the body of the metal, and give rise to new gases.

Influence of Time on Molten Alloys.

The properties of the alloy are largely influenced by the time taken in its preparation. Fig. 3 illustrates a bronze valve body cast with metal which had been kept molten in the crucible during the mid-day break. The casting came out very porous.

Deoxidisers.

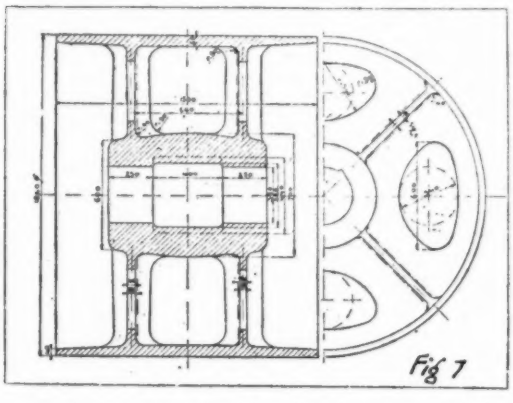
In order to eliminate these dissolved oxides, it is usual to add some substance which has a still greater affinity for oxygen. By this means the existing oxide is decomposed, and a new oxide of low density is formed which passes away with the slag. The added substances are called deoxidisers. For steel, aluminium, silicon and manganese are employed; for bronze, phosphorus, manganese or zinc serve this purpose. To protect the surface of the molten metal from the oxidising effect of the air, it must be kept covered with a layer of flux. The use of deoxidisers increases the strength and raises the density of the metal.



Contraction of Alloys.

As a metal solidifies, it contracts as the temperature falls. At the beginning of solidification the alloy increases in volume; the moment solidification is complete, contraction begins, but it has been proved that the contraction is not continuous, but is accompanied by small intermittent expansions. Contraction varies not only with different alloys, but also with the same alloy. It depends on composition, casting temperature and rate of cooling. The higher the casting temperature and the quicker the cooling, the greater will be the contraction; consequently the amount cannot be exactly predicted. As a general rule, the eutectic mixtures have the least and chemical compounds the greatest contraction. The property of contraction gives the founder great

trouble, and the difficulties are frequently aggravated by the design of the piece, which results in high internal stresses due to rigidity in certain directions. These stresses are induced when two large masses of metal are united by a thin section. The latter quickly solidifies and completes its contraction; as the larger masses slowly cool and begin to contract at the moment of solidification, the connecting section is put in a state of tension, which persists when the casting is taken out of the mould. This question of tension is most important, and can be well illustrated in the making of a cast-iron pulley. Considering what happens during solidification in such a casting, it will be recognised that the first portion to solidify and contract is the thin rim (see Fig. 4), the arms,



generally more massive than the rim, then solidify and contract; finally, the boss will solidify when all the other parts are already set. Since the arms are fast to the rim, they cannot follow up the contraction of the boss, and are consequently left in a state of tension. If the boss is excessively large in relation to the rim and arms, the pulley will break under the contraction stresses; it may be in the rim or in the arms, according to their dimensions. To avoid this accident, the boss should be as light as possible, and means must be taken to relieve the stresses by removing the sand around the boss in order to accelerate cooling. If the boss is exceptionally heavy, cooling may be accelerated by throwing water on it. By making the arms curved, as shown in Fig. 5, this tensile stress is relieved; unfortunately, the pulley with curved arms is more expensive to make, and there is also some prejudice against its appearance. As

Fig. 8.—Cast-Iron Pulley.

an alternative the wheel may be made in halves, as shown in Fig. 6, a device that effectually avoids the cooling stresses. Fig. 7 shows a pulley for the severe duty of driving a rolling mill; it was 6 ft. in diameter and running at 300 r.p.m. When made as drawn, the casting broke several times owing to the heavy contraction stresses set up by the massive boss and thin rim and webs. By altering the design, as shown by the dotted lines, the pulley was cast without further trouble. Every precaution was taken in the cooling process, and the casting was left in the mould for more than eight days; cooling of the boss by water, however, was begun on the day the pulley was cast. In spite of the improved design and the precautions during cooling, there is no doubt that, in the finished pulley, tensile stresses of unknown magnitude existed in the arms and webs. The composition of the iron for this casting was carbon 3.54, graphite 2.84, manganese 0.44, silicon 2.42, phosphorus 0.73, and sulphur 0.088 per cent. The metal was deoxidised in the ladle by the addition of 0.15 per cent. of ferro-silicon (45 per cent.). The transverse tests gave very good results, and the structure of the material is shown in Figs. 8 and 9. Tensile stresses of dangerous magnitude

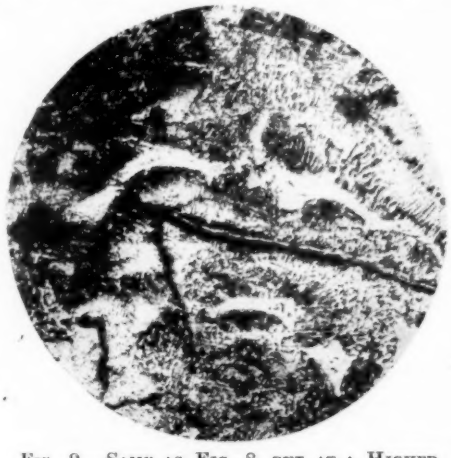
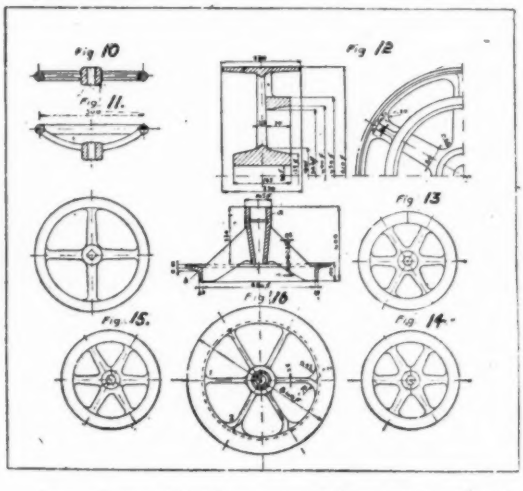


Fig. 9.—Same as Fig. 8, but at a Higher Magnification.

are set up in castings made in green sand owing to the rapid cooling which leads to increased contraction.

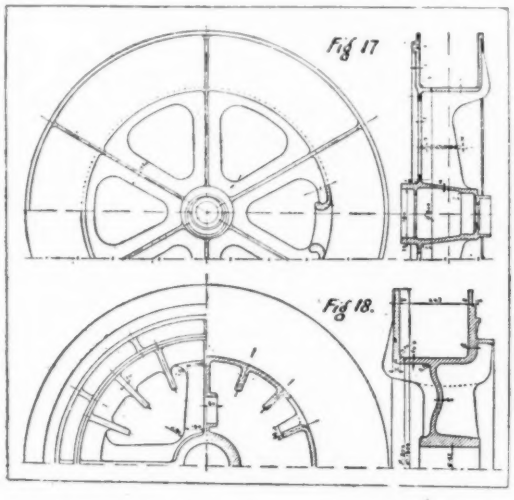
Design is an important feature in the attempt to ease contraction stresses; thus the hand-wheel shown in Fig. 10 is made with curved arms instead of straight (Fig. 11). With the arms curved, as shown, the boss can follow up the contraction of itself and the arms. In Fig. 12 is shown another case of bad design, a pulley with a brake rim, cast in one piece. It amounts, in effect, to two rims, one of which is very strong. The contraction stresses in this case were too great to be dealt with even when using a grey



iron of the following composition :—Carbon 3.46, graphite 2.78, manganese 0.51, silicon 2.35, phosphorus 0.74, and sulphur 0.08 per cent. The same difficulties are encountered in making flywheels; the rim consists of a much larger mass of metal than the arms and boss; the result is, that dangerous stresses are inevitably set up unless the design is suitable for their relief. This may be effected either by dividing the rim, as at Fig. 13, or dividing the boss as at Fig. 14, or, what is more usual, by making the wheel in separate halves. The stresses in small flywheels may be eliminated

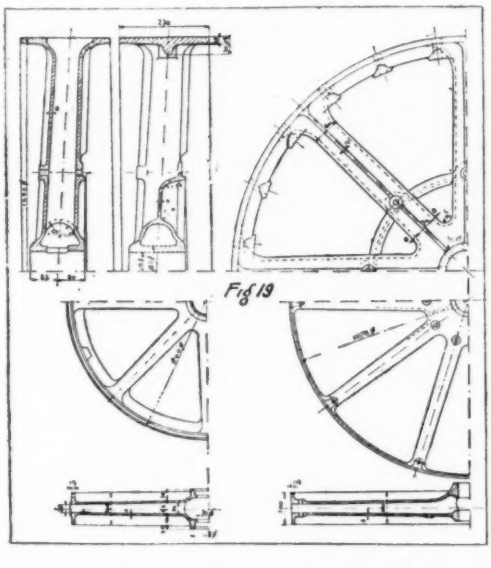
by parting the boss in three places, as shown at Fig. 15.

Contraction stresses are still further increased in castings made of alloys having a large amount of contraction; cast steel, for instance, which has a contraction almost twice that of cast iron. In order to avoid an undue proportion of wasters in steel castings, it is necessary to take the greatest care in the distribution of the metal. An interesting example in design is that of the steel turbine runner, shown at Fig. 16. The very strong boss "a" is connected to the thin portion "b" by



arms. At first the arms were made straight, as shown at "1" owing to contraction they broke. The difficulty was overcome by making the arms curved, as shown at "2."

Two instructive examples of steel castings are shown (Figs. 17 and 18); they are cable drums for steam ploughs. In Fig. 17 the metal is evenly distributed; all sections are of almost the same thickness, and the whole construction is light and elegant. In Fig. 18 the design is heavy and the metal badly disposed; the boss and the drum are too massive, with the result that several wasters were made owing to fracture of the drum in cooling. Fig. 19 shows three correct designs for steel wheels for motor lorries, etc. Tensile strains are produced when contraction is hindered; this may arise not only through faulty design, but also due to the unyielding nature of some part of the



mould, the core for example. The casting of hollow objects in materials having a great amount of contraction should be avoided for this reason. Strains are not due to faulty design alone; they may result from errors in moulding. At the joint of the moulds fins are formed on the casting. If the mould is not carefully made, these fins are thick. A thin fin solidifies more rapidly than the neighbouring material, and contracts just as the adjacent metal is setting. If this occurs at a critical point in the process of solidification, cracks may be started by the contraction of the fin.

(To be continued.)

Alloy Steels at High Temperature.

Messrs. H. J. French and W. A. Tucker, of the Bureau of Standards, Washington, have been investigating the strength of alloy steels at high temperatures. The following conclusions appear at the end of their report:—

(1) The effect of temperature rise to about 600 deg. C. is to reduce tensile strength and proportional limit and greatly increase ductility. Certain combinations of composition and treatment, notably normalised chrome-vanadium, quenched and tempered stainless, and air-cooled 28 per cent. nickel steels are strongest at ordinary temperatures, but carbon and the majority of alloy steels tested, show maximum strength and minimum ductility at temperatures within the range of 200 to 350 deg.

(2) The proportional limit of medium or low-carbon steel, which has been largely relieved of stress by suitable treatment, decreases with rise in temperature. In highly-stressed metal, resulting from cold or blue-work or quenching, and that having residual stress such as often exists in thin sections of hot-finished steel, the proportional limit either remains at approximately its room-temperature value over a well-defined interval, or shows an increase with the first rise in temperature.

(3) From the standpoint of high strength and limit of proportionality of steels at elevated temperatures, the temperature scale may be divided roughly into three parts: (1) the range 20 to about 450 deg. C.; (2) the range 450 to 600 deg. C.; (3) above 600 deg. C.

(4) In the lowest range, high strength and proportional limit are functions of composition and heat treatment and in general combinations giving highest strength at ordinary temperatures, show similar superiority throughout the entire range. It is, however, advisable to keep the carbon content low, since brittleness, illustrated by low values of elongation and reduction of area, increases rapidly with increase in carbon content, particularly in the blue-heat range.

(5) The upper limit in the second or transition range requires nearly full tempering following hardening, so that in most cases the benefits to be derived from heat treatment are limited except in the lower portion of the range, and high strength and limit of proportionality are largely functions of composition. While short-time tests, such as were carried out by the authors, do not give direct comparisons of steels subjected to sustained loads, on account of the importance of the time factor, it would be reasonably expected that steels having highest limits of proportionality would be able to sustain higher loads than those with low proportional limits, though not in direct proportion to observed values. On this basis of comparison it appears possible to improve the properties of steel by adding such elements as chromium, cobalt, uranium, molybdenum and vanadium. On the other hand, nickel, even in large proportions, appears to soften rather than strengthen steel in this range, particularly at about 550 deg. C. and above.

(6) It is known that the drop in strength and proportional limit at temperatures around 550 deg. C. is permanent, and that additional rise in temperature is accompanied by a further decrease in values, so that the described tests also throw light upon what may be expected at higher temperatures. It would therefore appear improbable that commercial steels can be produced, to withstand continuously fairly large loads at temperatures above about 650 deg. C. except when large proportions of one or more alloying elements are added to reduce the iron content to such low values that the resulting product cannot correctly be called steel, or in special cases where extremely large proportions of special compounds are present.

Templetown Silica Brickworks.

By the courtesy of Mr. A. H. Middleton, our representative was recently afforded an opportunity of going over the Templetown Silica Brickworks of the Consett Iron Company, Limited, Durham. The Consett Company have been engaged in the manufacture of firebricks for upwards of 40 years, and for many years also they have been, to a limited extent, manufacturing silica bricks for their own use.

That straight silica material possesses distinct advantages over fireclay and fireclay mixtures has been fully demonstrated by many years' actual experience, particularly in America, where silica is almost universally employed by gas engineers for the whole of the brickwork inside the shell of the coke-oven setting. Obviously, the quality of refractories necessary for the coke-oven wall and the gas retort are identical, namely, hardness, toughness, perfection of shape, and freedom from expansion—a combination somewhat difficult to obtain. The hitherto restricted use of silica bricks in this country has not perhaps been due to a failure of the gasworks engineer or the coke-works manager to appreciate the advantages of straight silica as a refractory, but rather to the fact that hitherto brickmakers in this country have not produced a silica brick equal in quality to those made in America or on the Continent. For this, the general process of manufacture has been somewhat to blame, but the main cause of failure has lain in the inability to burn the bricks on a commercial scale, at the high temperatures necessary to ensure complete conversion; and if this conversion is not completed during manufacture, the brick will have a large permanent or after-expansion in use.

As large coke-oven owners and operators, the carbonising problems were factors of paramount importance to the Consett Company. After a study of coke-works practice in America, the Company, on the advice of Mr. A. H. Middleton, decided to use silica in place of other refractories in the construction of the new coke ovens now in course of erection, which are designed to carbonise 6,000 tons of coal per week. At the outset the Company recognised that perfection of manufacture was a *sine qua non*, and as makers in this country could not, at that time, be found prepared to accept the very exacting specification, the Company, who have an almost unlimited supply of ganister available on their own property, determined to undertake the manufacture themselves, and to this end they purchased a small brickworks in the immediate vicinity of the Consett Works for experimental purposes. One by one, difficulties were overcome, but it was found impossible to meet the conditions for burning in the existing plant; in point of fact, in trying to reach the requisite temperature one of the kilns was actually melted. It was therefore decided to reconstruct the whole of the works. In the meantime Mr. Middleton made a second journey to America to study the silica brickworks practice of that country, as the outcome of which he decided that it was wholly impossible to obtain the requisite conditions by any reconstruction which could be carried out at the old works, and that a first-class silica brick could only be made at a works which had been expressly laid down for that particular duty. The work of reconstruction was therefore stopped and the erection of a complete new works decided upon. The old bee-hive ovens at Consett were just being dismantled, and the site they occupied has been given over to the new works.

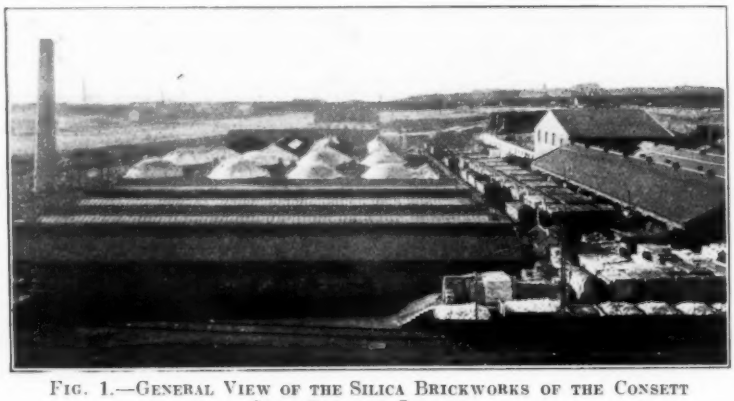


Fig. 1.—General View of the Silica Brickworks of the Consett Iron Company, Limited.

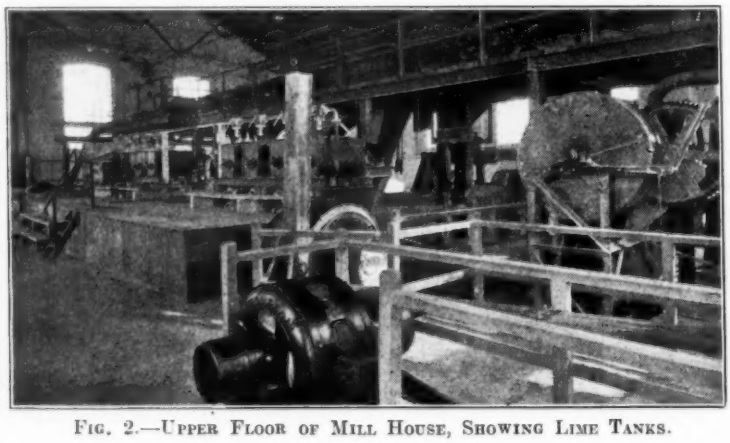


Fig. 2.—Upper Floor of Mill House, Showing Lime Tanks.

The Consett Company are to be congratulated upon their enterprise, for the brickworks as in operation to-day is one of the finest in the kingdom and, for its size, one of the finest in the world, not only in equipment, but particularly in regard to its layout. That the Company have

been justified in their enterprise is evidenced by the quality of the manufactures; the silica bricks and lumps are in every way excellent; but this perfection of manufacture has only been arrived at after lengthy and costly experiment.

As already stated, the ganister is mined in the quarries belonging to the Company, and is delivered in railway trucks to the sidings immediately at the rear of the works; opposite the sidings is the stocking ground, where space is available for the storage of 10,000 tons of ganister. The ganister is stacked according to grade, the grade being determined by the laboratory from which also the particular mixtures are obtained to meet the various routine or special requirements as the case may be. The weathering on the stocking ground helps to remove any outside dirt which may have been picked up by the stone during quarrying operations. A series of hydrants are, however, laid at intervals over the ground, and the stone is washed before passing to the works.

The ganister is delivered to the works at the rear of an Edgar Allen crusher, 24 in. × 14 in., in which the stone is broken down to 3-in. cubes, the broken stone being delivered by an elevator to a second similar crusher, in which it is further broken down to 1-in. cubes, and is delivered thence through an automatic feeder to a gravity bucket-conveyor. To provide for the storage of the surplus output over the normal demands of the grinding plant, three hoppers each of 30 tons capacity are provided. Dust is collected with a very complete system installed by the Standard Engineering Company, Leicester; so efficient is the system that there is nothing in either the atmosphere or the appearance of the shop to indicate that work of a dusty nature is being carried on. The crushing mills are driven by a Crompton 60-h.p. motor.

The grinding plant comprises two specially-designed mills built by the Brightside Engineering Company, Limited. The rolls are adjustable on their beams so as to give varying speeds, and the shafts are also adjustable to take various sizes and weights of rolls. The shafts run in Skeffko ball-bearings, and the mills each weigh 30 tons. The lime is prepared on the ground floor, where it is slaked in a wood tank, passing thence into one of the two agitators which are placed on either side, and, of course, worked alternatively. From either agitator the lime is pumped up into the measuring tanks above the mills. The milk of lime is sieved as it enters the tanks, which are fitted with revolving agitators, and the specific gravity of the liquid is adjusted for each particular requirement. A time record is kept of every grind, and this forms a portion of the record of every make of bricks or lumps. The mill pan is discharged by means of a hand-operated plough, by which the whole charge is completely cleaned out in half-a-minute, this rapid discharge being a very important factor, as it ensures all the material shall have had the same amount of grinding.

Each of the mills is driven by a 100-h.p. English Electric Company motor. The elevators and the agitators are driven by 15-h.p. Holmes motors. The mills are discharged into steel end-tipping bogies which run along an elevated alleyway at right angles to, and the full width of, the moulding shop, which is at a lower level, so that the bogies discharge direct into any of the seven hopper

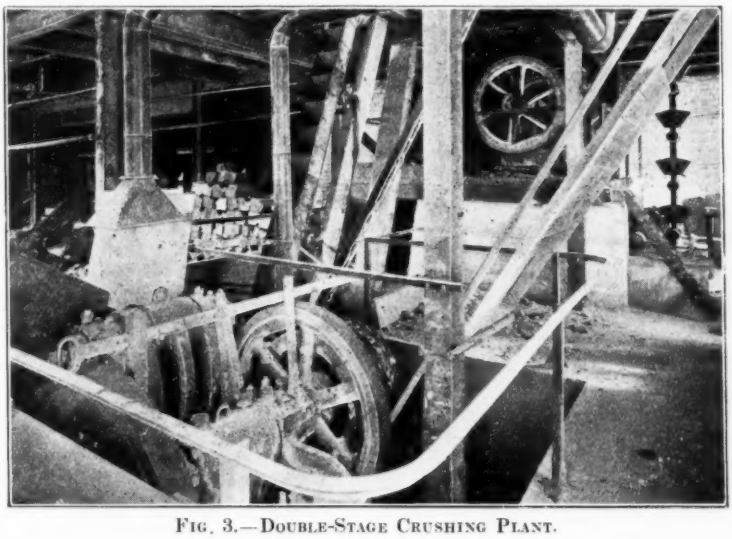


Fig. 3.—Double-Stage Crushing Plant.

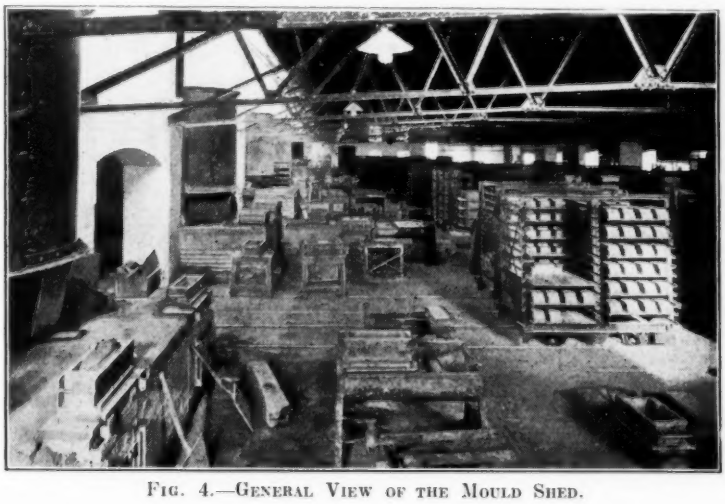


Fig. 4.—General View of the Mould Shed.

shoots, each shoot feeding a double moulding table, and at each table work two moulders with their helpers. The moulds are filled by flinging, and from this point onwards the material is not again handled until the bricks are stacked in the kilns. This is an all-important factor in the production of the finest quality of silica bricks, in which perfect shape and true faces are vitally essential.

The moulded bricks are, by means of a simple but ingenious turnover device, turned out upon pallets, which are placed upon rack-cars with roller bearings, built by Robert Hudson, Limited, Leeds. There are two lines of bogie track opposite each of the moulding tables, and these feed on to a transfer car which serves a line of track the full width of the moulding shop. The transfer car delivers the loaded rack-car to either of the two Proctor dryers, which are each served with three lines of track, parallel with the moulding floor, but at right-angles to the transfer-car track.

Each of the Proctor dryers has a chamber 48 ft. × 20 ft., and is heated by steam pipes placed below the floor level. The air is circulated by eight fans, which are placed, staggered, four on either side of the chamber. A small auxiliary fan is employed to exhaust the moist air. The cars are pulled through the chamber by link chain, which engages with the framework on the cars. The fans and conveyor are driven by a 25-h.p. English Electric motor. The arrangement is such that the heat in the chamber is graduated, the heat immediately at the entrance being moist, which ensures that the bricks shall be thoroughly warmed through before any drying effect takes place upon the outer skin; this is what may be called soaking before drying. The time occupied in drying varies, of course, with the size of the material going through, but 14 hours may be taken as a minimum with 84 hours as a maximum. Obviously, however, the speed of the dryer will be governed by the time taken for the largest lumps; generally speaking, therefore, it is the practice to dry out the very large lumps on the floor, a portion of which is steam-heated for that purpose. Steam pipes are laid completely through all the shops for heating purposes during the cold weather.

From the drying chamber the rack-cars are travelled to either of the kilns being charged. There are eight special kilns, each of a capacity of 100,000 9-in. bricks. Four of these kilns are built entirely of Consett bricks. A visitor will be impressed with the exceptionally robust construction of the kilns, not only in regard to the brickwork, but also the steel bracing; however, the Company have learnt from experience that something more than an ordinary kiln construction is required to stand up against the exceptional temperatures at which the kilns have to operate. The waste heat from the old beehive ovens was utilised to dry the bricks in the fireclay works, and it was at first thought the waste heat from the kilns might be employed for a similar purpose; this, however, did not prove wholly satisfactory in operation, and has now been abandoned. The waste heat from the kilns is now to be utilised to raise steam for the silica brickworks, for which purpose a Babcock waste-heat boiler is being installed, and this will be served by a Sirocco fan, which, for ease of regulation, will be steam driven. Steam will be raised at 160 lbs. and superheated 100 deg. Fah. A stack sufficiently high to pull through the spent gases from the kilns, should it be necessary to by-pass waste heat for boiler-cleaning operations, is also in course of construction.

Under normal working conditions, it takes

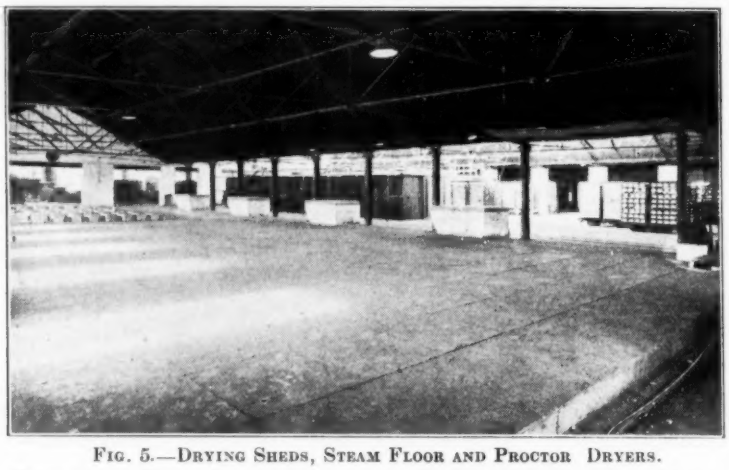


FIG. 5.—DRYING SHEDS, STEAM FLOOR AND PROCTOR DRYERS.
TEMPLETOWN SILICA BRICKWORKS OF THE CONSETT IRON COMPANY, LIMITED.

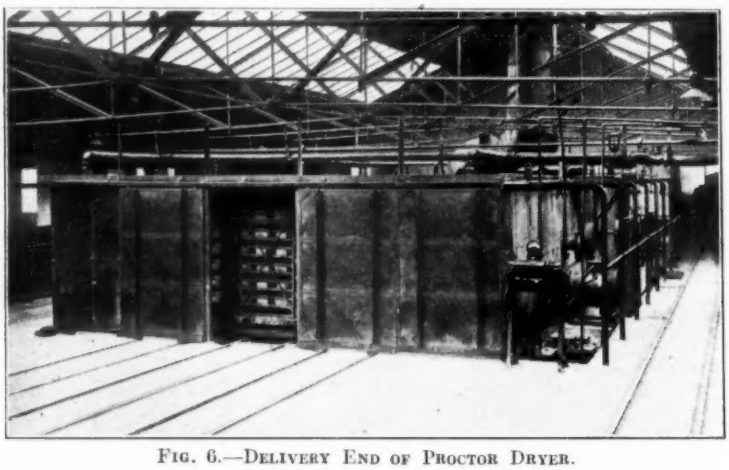


FIG. 6.—DELIVERY END OF PROCTOR DRYER.
TEMPLETOWN SILICA BRICKWORKS OF THE CONSETT IRON COMPANY, LIMITED.

approximately five weeks to turn a kiln. The full capacity of the plant is 600 tons of material or, on straight bricks, 200,000 per week. There is perfect technical control of all operations. A large central laboratory designed to serve the cokeworks and brickworks is now nearing completion; in the meantime the brickworks laboratory is particularly well equipped for its work. All material is tested before passing to the works, the ground material being graded and screened, whilst for the finished product there is an electric furnace for testing refractories, a second electric furnace for taking a refractory test under load, and also a gas-fired furnace by British Furnaces, Limited, set off for testing expansion. Optical and recording pyrometers by the Cambridge Scientific Instrument Company are in service. Lime-content and analysis are also taken of every make, the records being carefully and systematically kept, so that it is possible to repeat with accuracy and certainty a particular mixture which has proved in the manufactured article most suitable for a specific duty. The laboratory has also set off for its use a small experimental kiln, an unusual, but very valuable, addition to brickworks laboratory equipment.

The Consett Company, being themselves users of silica bricks, are able to take their own medicine, to experiment upon themselves rather than upon their customers, and this is precisely what they have done; their work now, however, is standard and no longer experimental. A walk over the coke ovens in course of erection furnishes convincing testimony in regard to the shape and finish of the bricks and lumps. Bricks picked up haphazard and placed face to face made a perfect joint, and this is no less remarkable than the perfect uniformity in size. The bricks are also remarkably tough. The lumps could only be broken with blows from a sledge hammer, the fracture then revealed being remarkable for its uniformity. The appended recent tests, made in accordance with the standard methods specified by the Institute of Gas Engineers and the Refractories Committee of the Ceramic Society, upon Consett silica refractories are both interesting and instructive:—

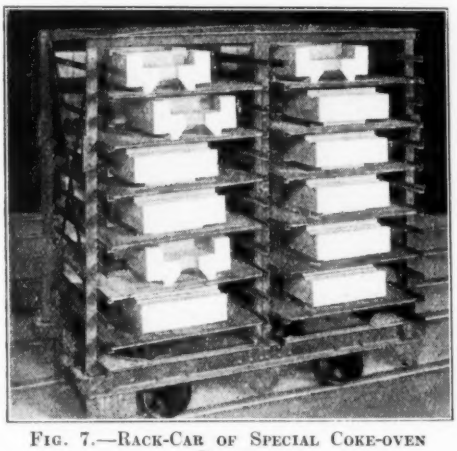


Fig. 7.—Rack-Car of Special Coke-oven Shapes.

Recent Tests on "Consett" Silica Refractories.

Crushing strength (cold)	3,500 lbs. per sq. in.
Refractoriness	1,720 deg. C. (Cone 32-33.)
Refractoriness under load of 50 lbs. per sq. in.	1,670 deg. C. (Cone 30.)
Porosity	Shapes 26.27 per cent. Bricks 29.31 per cent.
Apparent density	Shapes 1.72 Bricks 1.62.
Density (powdered)	2.34.
Conversion of silica	Unconverted quartz = trace. Tridymite 30 per cent. approx.
Permanent linear expansion at 1,350 deg. C. (Cone 12.) (2 hours' heating according to the Gas Engineer's Specification.)	Nil.
Contraction after heating for 1 hour at 1,600 deg. C.	=0.6 per cent.

Naturally, the cost of the pure silica brick is considerably higher than the semi-silica brick of commerce, but then in bricks, as in other material or apparatus used in the process of manufacture, initial cost is not, or at least should not be, the dominating factor; the relative costs must be considered on a tonnage basis of the output production, and in this respect probably it will be found that the advantages of the silica brick more than counterbalance the difference in initial cost.

In the first place, at temperatures over 1,000 deg. C., silica has a greater heat conductivity than fireclay, and this leads to a reduction in the carbonisation period, whilst time is also saved in reheating the oven walls to working temperatures after recharging the oven. Again, silica retains its rigidity and strength under load to temperatures well over 1,600 deg. C., so that constructions of silica can be safely worked at temperatures wholly impossible with fireclays or semi-silica material. Obviously, to obtain the best advantages of the silica brick, the use of a suitable cement is necessary. Ground ganister is suitable from a refractory point of view, but, as is well known, this will not form an adhesive joint. As the outcome of experiments, the Consett Company have introduced a special cement which neither contracts nor expands during heating, for use with silica shapes, etc., and this, whilst possessing the refractory properties of silica, makes a perfectly adhesive joint without cracks.

Glenfield & Kennedy, Limited, of Kilmarnock, have secured a barrage contract from the Irrigation Department of the Government of India of the value of approximately £80,000. The order includes thirty steel sluice gates, each 50 ft. wide by 11 ft. deep, four of 50-ft. width and 13-ft. depth, and sixteen of 20 ft. by 6 ft. 4 in., together with all the necessary gearing.

Aluminium-Alloy Rivets. — The properties of aluminium-alloy rivets have been investigated by Dr. W. Rosenhain and Mr. S. L. Archbutt at the request of the Airship Department of the Admiralty. The samples received from the Department proved on analysis to have the following composition:—Silicon, 0.33; copper, 0.89; manganese, 0.32; iron, 0.52 per cent.; magnesium, nil; remainder aluminium. A sample of rivets from Messrs. Short Brothers' works at Bedford gave the following composition:—Silicon, 0.28; copper, 0.54; manganese, 0.14; iron, 0.52 per cent.; magnesium, nil or trace; aluminium, remainder. The general conclusion which may be drawn from the tests made on this rivet material, duralumin and other rivets, and on joints made with all these, appear to be as follows:—(1) The use of very soft rivets consisting of nearly pure aluminium does not appear to be necessary, since perfectly satisfactory joints can be made using either cold-drawn and annealed wire of 3/20 alloy (copper 3, zinc 20, aluminium 77 per cent.) or duralumin wire, and, since both these materials give very much higher shear stresses than does soft aluminium wire, there is every reason in favour of the use of the harder material. Careful examination has shown no evidence whatever that riveted joints made in these harder materials show any tendency to cracking or deterioration in the course of many months after manufacture. (2) Rivets made of cold-drawn 3/20 alloy wire annealed at 250 deg. C. give the highest resistance to shear of any of the materials tested, viz., an average value of 17 tons per sq. in., whereas heat-treated duralumin gives values of the order of 16.4 tons per sq. in. Rivets made of 3/20 wire can be closed readily and have the great advantage over duralumin rivets that they can be used at any time after annealing, and that they do not require frequent reheating and quenching. Provided, therefore, that all the wire for the riveting shop has been suitably annealed, there is no reason why rivets in an unsatisfactory condition can pass into use, or that the proper heat-treatment will be evaded or avoided in order to obtain softer rivets. (3) Where it is not desired to introduce 3/20 rivets into a duralumin structure, the use of properly heat-treated duralumin rivets appears to be perfectly satisfactory. The only possible objections are those arising from the necessity of using rivets soon after they have been quenched, and the relative hardness of the rivets for closing up purposes even when thus used. If these objections are found to be serious in practice, a somewhat softer alloy (copper 2.25, magnesium 0.50, magnesium 0.50, aluminium 96.75 per cent.) can be used giving a shear strength of a little over 12 tons per sq. in. This, however, also requires heat-treatment similar to that employed for duralumin.

Designing and Equipping a Foundry Laboratory.

By H. H. Shepherd, M.I.Brit.F.

(*Continued from page* 307.)

The Chemical Laboratory.

All the benches are recommended to be fitted with a plain teak top. The writer does not favour the white tile facing. There are, of course, two advantages attached to the latter—namely, neatness of appearance and increase in the natural lighting value; but white tiles are too hard a material, and in consequence add distinctly to the breakages bill unless extreme care is taken. To make this apparent it is only necessary to point out the care required to manipulate vessels full of liquid. Even on a wooden top their fragile nature is well known. From the point of view of breakages, the lead-topped bench is undoubtedly the best, but here again difficulty is encountered owing to the fact that lead buckles so when heated.

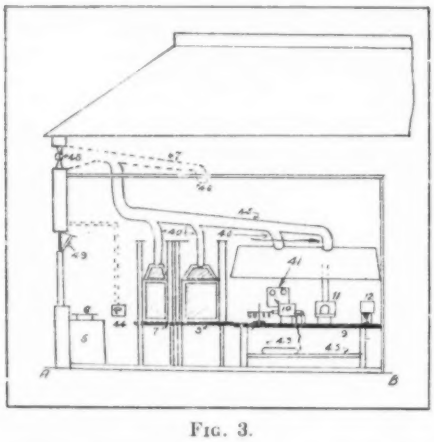
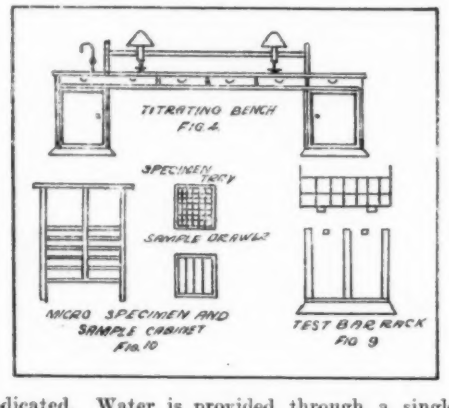


Fig. 3.

All these minor points, as they may be termed, are in reality of much importance, and their observance and consideration add to the efficiency and smooth working of a laboratory. However, in regard to benching for most general purposes, the plain wood top is undoubtedly the best type. It can be kept from any extensive damage by acids, etc., by occasional treatment with linseed oil.

Titrating Bench.

The titrating bench has overall measurements of 12 ft. × 2 ft. 3 in. × 1¼ in. × 3 ft. high. Its design is illustrated by Fig. 4. It will be noted that ample knee space is provided; this is a distinct advance in titrating work. Drawers for storing burettes, pipettes, and glass tubing are



indicated. Water is provided through a single-way tap, in conjunction with which there is a sink measuring 10 in. × 10 in. × 6 in. deep, while the gas supply is maintained by two double-way Bunsen fittings. These may be advantageously fitted with two incandescent burners (Fig. 5), which supply an excellent artificial light for burette work when the general lighting system is not favourable to any particular work. Incandescent gas mantles tend to give a more natural light than does electricity.

Fume Cupboards.

Two fume cupboards should be erected, especially if non-ferrous work is likely to enter into the

Fig. 5.—Combination Bunsen Burner Connection and Incandescent Lamp for Titrating Illumination.

laboratory curriculum. A very serviceable pattern is that shown by Fig. 6 and made by Baird & Tatlock, of London. The smaller one (Figs. 1 and 3, No. 7), is fitted with a slate base 24 in. x

Fig. 6.—Fume Cupboard.

24 in., and it has a total height of about 8 ft. This cupboard is to be used for storing and use

of the sulphuretted hydrogen apparatus. It is provided with one gas tap. The counterpoised door is hung on catgut; ordinary rope, cord, or chain very soon corrodes or rots. As a further precaution it is a good plan to have fitted two small bolts at each side of the door, with bolt holes fitted at varying heights in the door framing.

The larger cupboard (Figs. 1 and 3, No. 8) is similar to the small one in construction except that it is larger, the slate base being 3 ft. or 3 ft. 6 in. × 2 ft. It is used for the evaporating of noxious liquids. An evaporating plate of cast iron should be made to fit this cupboard and heated by means of a Fletcher Russell "Standard bar type" burner, having a flame length of 18 to 24 in. With this burner the plate can be heated in such a way as to permit gradual and rapid evaporation of liquids to take place equally.

trated in Fig. 7, but it will be found preferable to omit the two centre halves of the cupboards and so permit greater knee space. It is the opinion of the writer that the tendency of laboratory furnishers is to fit too many cupboards to benches. They are not by any means a convenient means of storage. A store room or large apparatus cupboards are much to be preferred, since apparatus, chemicals, etc., can be kept together, close at hand, and can be taken from the stores or apparatus cupboard without inconveniencing those working at the benches. This centre bench should be used for general work.

The bench (Fig. 1, No. 15) is fitted to take the

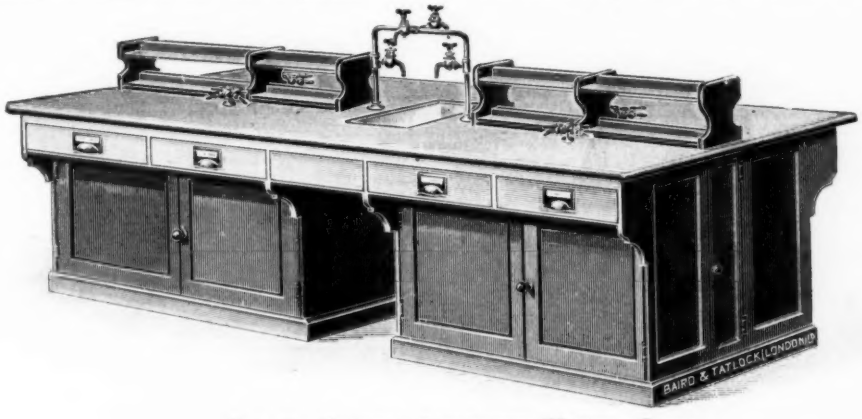


Fig. 7.—Chemical Laboratory Working Bench.

Bench Considerations.

The ignition bench (Figs. 1 and 3, No. 9) is of York stone or slate. It should be mounted upon brick columns or stout wood supports. Beneath the bench and about a foot from the floor is fixed a shelf of the same length and width as bench.

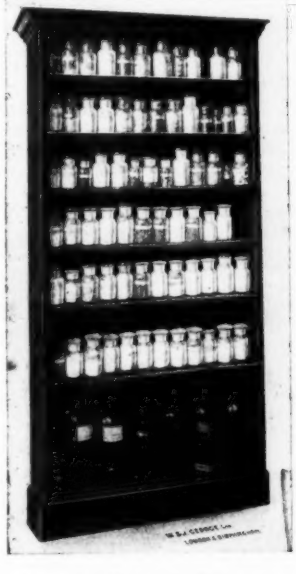


Fig. 8.—Reagent Shelves.

This is fitted to take the oxygen cylinder, retort stands, and other apparatus. The gas supply is provided from a 2-in. main through to at least two taps of size to $\frac{5}{8}$-in. piping, and one double-way $\frac{1}{4}$-in. pipe tap.

The centre chemical bench allows for working both sides. It measures 8 ft. × 4 ft. 6 in. × $1\frac{1}{8}$ in. × 3 ft. high. A suitable type of bench is illustrated in Fig. 1, No. 16. It is fitted with a still and water oven, and for the washing and draining of apparatus. Its overall measurements are 10 ft. 6 in. × 2 ft. 3 in. × $1\frac{1}{8}$ in. × 3 ft. high. It is grooved and inclined at one end to allow draining, and is provided with a sink 24 in. × 18 in. × 9 in. deep, fitted with two single-way water taps. This large-sized sink is an advantage, as it provides a medium for the cooling of freshly-prepared solutions such as sulphuric acid, etc. For this purpose it should be fitted with a *lignum vitæ* plug. Gas supply to the bench is provided by one $\frac{1}{2}$-in. and two $\frac{1}{4}$-in. double-way taps.

Fig. 11.—Electric Furnace for Carbon Determinations.

At least one store cupboard should be included in the furniture of the laboratory. It is not required to be elaborate, and one made in pitch pine and having dimensions of 7 ft. 6 in. × 4 ft. wide will be quite satisfactory. The upper portion should be fitted with two glass doors and adjustable shelves; the lower portion is best fitted with two plain wood doors.

In addition to a store cupboard, it is necessary to have a set of shelves for storing the acids and chemicals which are in regular use.

The Physical Laboratory.

A concrete sample preparation bench is recommended as a very useful fixture. The one shown

measures 4 ft. × 2 ft. × 2 ft. 6 in.; the concrete top (Fig. 1, No. 26), preferably reinforced, has a thickness of 2 to 2½ in., and is supported upon a brick bed built up from the foundation.

A tool and micro-specimen preparation bench is provided for. It should be of well-seasoned and stout wood 1½ to 2 in. thick, provided with a cupboard fitted with sliding doors. Above the latter should be a 5-in. deep drawer, and along the back of the bench an 8-in. wide shelf. A double-way ¼-in. gas connection should also be fitted.

Fig. 12.—Gas-fired Type of Muffle Furnaces for Quantitative Gravimetric Analysis.

To obtain drillings for analysis, the writer's experience in respect of pig-iron is that an horizontal drilling machine is more efficient than a vertical one, as the section to be drilled can be more easily secured, and the drilling can be collected more easily and without loss. All the gears should be kept in good running order, and

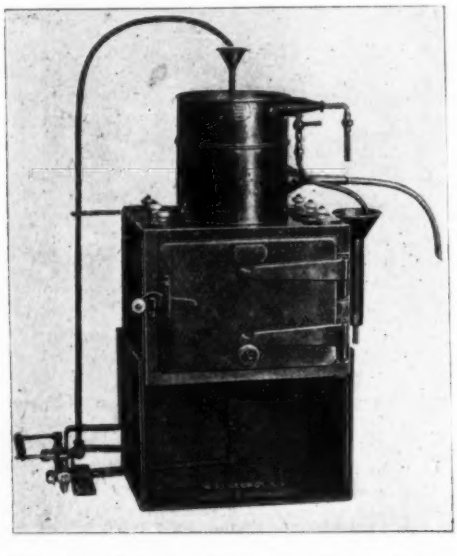


Fig. 13.—Combined Still and Water Oven.

used to obtain speeds which are particularly suitable to the class of material being drilled. A little attention to this results in considerable lengthening of the life of the drills and in the production of suitable drillings. If a vertical drilling machine is used it should be fitted with a clamp for holding pig-iron and other awkward sections.

A very serviceable and inexpensive test-bar rack, designed by the writer, is shown in diagram by Fig. 9. Its overall dimensions are 5 ft. 6 in. × 3 ft. 6 in. × 1 ft. 3 in. deep. The lower portion is designed to carry large (42 in. × 2 in. × 1 in.) transverse test bars, and the upper portion small or other test bars. A space of 1 ft. is

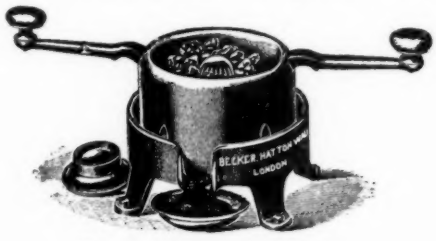


Fig. 14.—Grinding Mortar.

allowed between the upper and lower portions to permit easy removal of the large bars.

To support a testing machine of the type illustrated by Fig. 16 a stout wooden bench or concrete bed is necessary, the latter to be preferred. This enables the machine to be supported at a suitable height for operating. The plan of the bed is shown in Fig. 1, No. 31. It is built up from the foundation, and measures 7 ft. × 2 ft.

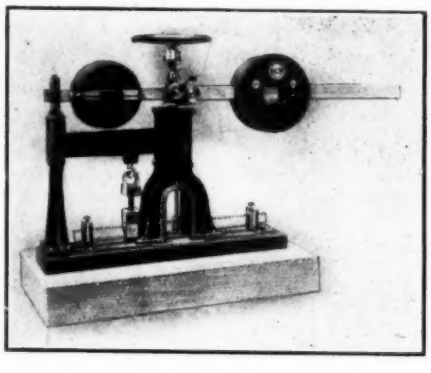


Fig. 15.—Transverse Testing Machine.

× 2 ft. 6 in. high. A brick bed faced with glazed bricks adds to the appearance of the laboratory, and may be preferred to wood or concrete.

The Microscope and Dark Room.

This room is designed for use as a developing room as well as for visual microscope work. The developing bench (Fig. 1, No. 19) has a length of about 5 ft. and a height of 3 ft. It is fitted with

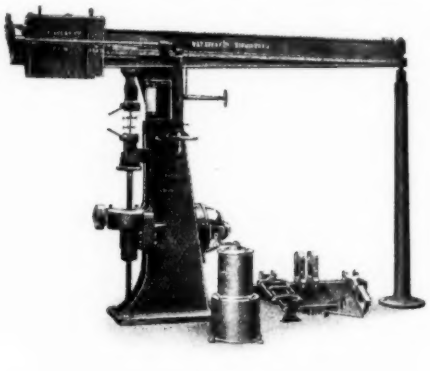


Fig. 16.—Large Tensile Transverse and Crushing Testing Machine.

a small sink 10 in. × 10 in. × 6 in. will be found a suitable size, provided with a single-way water tap. At the right-hand end of the bench is fitted an 18 in. × 12 in. × 4 in. drawer, and beneath a single-door cupboard. The electricity supply for a developing lamp is obtained by a plug and

switch attached to a wall switch. The microscope bench should be teak topped, 5 to 6 ft. long and 2 ft. wide. The wooden supports for this bench should be stout and set at such a height that the bench top is 3 ft. from the ground level; to avoid vibration, it is recommended that the supports be set in concrete to a depth of 4 to 5 in.

Another very useful addition to the metallography section of a laboratory is the employment of a small opaque white screen upon which the image of a section under the microscope can be reflected. The writer has used a 2-ft. square screen fixed as shown in Fig. 1, No. 21; its practical value is considerable. Inspection of the section is rendered easier, there is practically no eyestrain, and what is more, it enables examination to be made by more than one person at the same time, so increasing the value of the examination and probably the amount of information obtainable; further, it permits or presents to the operator a splendid opportunity of demonstrating to managers and others interested the practical value of the microscope in revealing faults and their effect upon the metals dealt with. Such friendly consultations help greatly the attainment of co-operation between the craftsman and the metallurgist, and any thing or scheme which tends to increase the spirit of "science hand-in-hand with labour" is at least worth trying.

The Office.

The only furniture that needs mention in this department is the micro-specimen and sample cabinet. It is illustrated in Fig. 10, and measures 4 ft. 6 in. × 3 ft. wide and 18 in. from front to back. The upper section consists of a double cupboard having fittings for wooden trays, which are sectioned off into small spaces 2 in. × 2 in. for micro-specimens. Each tray is numbered, the numbering being in accordance with the number of sections in the tray and the latter's position in the cabinet. By adopting a system of this type and entering particulars of the specimen and its place in the cabinet in a record book, the particular specimen required at any time can be readily obtained and referred to.

Drainage and Water System.

When designing the laboratory of a London firm, the writer adopted the system of laying the drain and water pipes together in a single channel cut in the floor (Fig. 1, No. 34). By this means the water supply was brought directly to its respective outlet without the unsightly appearance of pipes traversing the laboratory. It may also be found convenient to lay the gas-supply pipes in the same channel.

The drain pipes should be of glazed fireclay and have a diameter of at least 3 in. Connection to the sinks should be by fireclay or lead "S" traps fitted with screw plugs for permitting the cleaning out of solid matter—glass, etc.—which may be carried from the sink.

(To be continued.)

Economics and Psychology in Industry.

This subject was discussed at a joint meeting of Sections F (Economics) and J (Psychology) of the British Association at the Annual Meeting at St. George's, Liverpool.

Psychological Standpoint.

The first Paper was by MR. ERIC FARMER, who dealt with the subject from the point of view of the psychologist. One of the most fundamental concepts of economics, he said, was that of reward, by which economists sought to determine what were the means that would induce men to perform certain tasks. The economist could take one of two attitudes in considering the concept of reward. He might use the term in a material sense only, and in this case he would mean monetary reward; but the fact that during boom periods some firms suffered from scarcity of labour and a high labour turnover, while other firms in the same district and in the same industry suffered from neither to anything like the same degree, pointed to the fact that a standard rate of wage was not in itself sufficient to satisfy the demands of workers. The other way in which the economist might use the term "reward" was to include in it all the factors which operated in inducing men to perform certain tasks.

Besides the economic incentive there was a whole group of personal incentives, which played a very large part in the lives of the workers. The author then dealt with those incentives which were found inside the factory, in order to show how large a part the psychology factor played. The personal relations between managers and foremen and their workpeople were very closely connected with efficiency, and those who would organise industrial effort well must have a wide human understanding. Given proper incentives, how could one best assure their free operation to the economic advantage of the community and the worker, while paying special regard to the health and well-being of the latter? Incentives would not operate unless the conditions affecting their operation were such as would make it possible for them to do so.

In conclusion, the author put forward the suggestion that there should be joint research carried out by economists and psychologists, either in some industry or on some specific problem common to all industries, because, as a psychologist engaged in industrial research, he was continually faced with economic problems, the solution of which he was unable to attempt. Some of the problems which might be approached in this way included the question of whether it was better for a firm to bear its own accident risks, and presumably be more careful to avoid accidents, or whether it was better to pass the risk to an insurance company and so avoid sudden demands upon its resources caused by heavy compensation; or whether, in times of slack trade, it was better to work alternate weeks or short time each day, having regard to overhead charges and the effects on motor dexterity caused by complete rest and short periods of work each day.

Economic Standpoint.

DR. P. SARGANT FLORENCE then discussed the question from the economist's point of view. He agreed with the suggestion for joint research, pointing out that there were many problems which the economist would like the psychologist to answer. For instance, it was doubtful how far the division of labour was an economic advantage, and this was largely a matter of psychological experiment in order to come to a conclusion. It seemed to him that there were definite limits to which the division of labour could be carried.

Dealing with improved conditions, he pointed out that it cost money to produce an atmosphere which would give a certain data reading in a factory and the business man wanted to know whether the expenditure was worth while. Probably economists would be able to convince some of the large manufacturers, however, that it was, but, if they could not, then they must show that it was to the national advantage that such an improvement should be brought about, and that a certain amount of this work would have to be paid for nationally. Unfortunately, economists had not secured data from the employer with regard to these matters, and, in the present state of economics, and in the direction in which economics were going, he saw no signs of improvement. He was afraid Mr. Farmer was engaged in a hopeless quest for help in these matters if he appealed to the average sort of economics taught in our universities to-day.

In the course of a discussion, SIR W. H. BEVERIDGE, K.C.B. (President of Section F, "Economics"), remarked that economists had got past the idea that if an employer paid more wages he obtained a greater output—there was a saturation point beyond which this theory did not extend—just as they had got past the idea that low wages were the cheapest. As to the statement that economists had not carried out research, this was not true. The Universities of London and Cambridge were working together in collecting economic statistics, and that was a research into the trade cycle.

HENRY HOPE & SONS, LIMITED, of Smethwick, Birmingham, have received the contract for the steel windows for the new General Post Office, at Shanghai.

XUM

Institute of British Foundrymen.

EAST MIDLAND BRANCH.

The first meeting of the session was held on September 29, at the Loughborough College.

The new President, Mr. S. H. Russell, of Leicester, opened the proceedings by delivering his presidential address.

PRESIDENTIAL ADDRESS.

Gentlemen,—In the first place, I wish to thank the members for the great honour they have done me by electing me as President of the East Midlands Branch, and not only to me, but to my native town, Leicester. We of Leicester are all very proud of our City, of its past history, of its cleanliness, and jealous of its future, and whilst the industry I represent is not numbered amongst its more important, yet it is a large and growing trade of the kind particularly required in Leicester, owing to the staple industries employing such a large proportion of female labour.

The retiring Branch President, Mr. W. T. Evans, in his address during the last session very ably dealt with many of the problems which confront us, so that to-night I wish to emphasise an ideal, *the ideal of service*.

Service to me means something more than that as advertised by several of our leading motor-car manufacturers, though if properly carried out, service of that sort is beneficial to both customer and seller. As a member of the Institution of British Foundrymen, I want to see personal service given by all the members, an honest effort to give their best, and one of the first ways in which this can be done is by making regular attendance at the meetings. If we get small meetings the quality of the work done rapidly deteriorates, the lecturers feel disheartened, and the discussion following the paper flags owing to the absence of men with different view-points, and a good discussion is usually the more educational portion of the meeting. I sincerely hope that no member of any Branch will hesitate to join in any discussion because he fears that he may not express himself clearly. Any man talking about a job he understands and *knows* is always given a good hearing anywhere.

Another way of rendering service is by freely and openly meeting your competitors when you run across them. I sincerely hope that the day has gone by when each man kept all his knowledge to himself and looked upon other men in his own industry as enemies. Many of you, probably all of you, have found out that the man who is doing the job you would like to do is, after all, not such a bad fellow, and that co-operation and trust are better than suspicion and jealousy.

The greatest need in our industry to-day is education. Much can be done by placing special facilities before all the boys and youths to attend evening classes at the Technical Schools, but with the type of boy we so often get in the foundry this is a disappointing and often a heartbreaking job. They were up against this problem in Leicester during the last few days. When, two years ago, they started courses in foundry practice a good number attended and the classes were a success—possibly because many youths and men were waiting for the opportunity. The second year's course was also successful and the new course also fairly well patronised, but this year neither the first nor second year's course had attracted students. They did not know how to alter this, for the problem was only just before them. The great disadvantage they found was that the average boy had not sufficient elementary education to enable him to attend a suitable course of technical training, and they must increase the standard of elementary education if they were to get the best results. Attendance at evening classes was also admirable before the technical course.

Still we must persevere and do all we can to attract the right class of boy into the works. But we cannot stop at that. Many of the men will have had no education as we know it, but they can often turn out a wonderfully good job. If the various problems foundrymen will be always up against are discussed with these men, you will find that you are educating one another, and that you are learning more than you have imparted to the other man. Use all the influence you can to keep the shops clean and tidy. So many foundries take advantage of the fact that, by reason of the size of the foundry, as against the number of men employed, whitewashing cannot be enforced by a Factory Inspector, with the result that these foundries are dark smokey holes, depressing the spirits and lowering the quality of work of all who are so unfortunate as to have to work in them.

To come to more material things, service can best be carried out by always aiming at a high standard of production. We may be making nothing more important than fire bars, but it is necessary to make these better than they have been made before, and not to be satisfied with merely the quality of casting the customer expects. Give him something better, and whilst probably he will not trouble to thank you or even to tell you how nice they are, in the long run you will find that the quality of your work is building you up a reputation for good workmanship, which is synonymous with *service*.

One of the most trying of duties devolving upon our members is the examination of waster castings. Personally it always gives me a pain, but really thorough and patient investigation is amply repaid, and a foundryman receives more practical education from waster castings than from any other source.

Perhaps another of the hardest things we have to do, is to listen to the complaints of the engineering shop. The standard of quality demanded by the engineer becomes higher every year; it is no use grumbling about this, the higher quality must be obtained somehow. Let the engineer pour forth his tale of woe, and discuss with him any modification which may help to produce a sounder job. If this cannot be done, take it back to the foundry and puzzle over it until you find a solution of the difficulty.

In connection with this question of faults developing in the machine shop, we have found a "Complaints Record System" of value. The castings may have been made for some weeks before they are found faulty, and perhaps a further batch will not be required for a few months. We file on a card details of the complaint and a suggestion for curing same, the card bearing the pattern number of the part and the customer's name for index purposes. As orders are received a search is made through the complaint records, and a copy of any complaint is then attached to the pattern to ensure attention in the foundry. Lastly, may I put in a plea for two associations, which are prepared to render to you real *service*. Firstly the Institute, which through the pages of The Foundry Trade Journal, and through its annual copy of the Proceedings gives to us all a wonderful quantity of practical and technical information: and secondly, the British Cast Iron Research Association, which will become a pillar of strength to our industry if its work is not crippled and hampered by lack of support. Both of these associations depend in the end upon the support and activity of the ordinary member, and I appeal to you all to give yours wholeheartedly.

DISCUSSION.

Mr. H. H. Moore (past Branch president, Herbert Morris, Limited), said he could justly say on behalf of all members of the Branch, they were delighted to see Mr. Russell in his new position. He had enlarged on several points of very great importance. He had mentioned the question of service, and that was very apt and very timely, because this question of service is one of such great importance. This was the spirit one wanted, for it was quite as essential that an employer should give service to his employees as employees to give service to employers. Service could be regarded in many ways, and was not merely a question of co-operation and co-ordination. Probably there was more co-ordination in foundry works generally than ever before. In regard to apprentices it was very disappointing to hear from

Leicester that the effort for training foundry apprentices was not so successful as could have been wished. On the other hand he thought probably the apprenticeship system does not allow of full success. They wanted to see the very best type of lad taking up foundry work in its entirety. In Loughborough they had the advantage of the College and the Junior Technical College and were enabled in their apprenticeship system to select apprentices from the best boys in the elementary and secondary schools, and they were thus rather successful on account of the facilities provided, for elementary schools were also pretty efficient.

In their own works the apprentices started in the pattern shop, and they gave the boys a chance to learn to read drawings, for the apprentice just as with other boys had to learn how to learn. So the apprentices learned how to construct patterns, but primarily how to read drawings. After six to nine months in the pattern shop they went into the foundry, for it was essential for anyone who desired to learn mechanical engineering they should know something about foundry practice. Their boys remained in the foundry from six to twelve months, and some, he was pleased to say, stayed on. He was glad some of the apprentices were there that night, and he hoped all Loughborough apprentices would become associates of the branch, and his firm would be prepared to pay the fees.

With regard to the question of waste and inspection, he was delighted to hear from Mr. Russell they kept records so that when similar castings came to be made they could look up the records and see what difficulties were experienced.

The members of the Branch appreciated the useful service Mr. Russell had rendered from the inception of the Branch; he was one of the founders, and he hoped that during his period of office all meetings would be exceptionally well attended. He must congratulate him and the Council on the programme this year. He could venture to assure their new President of loyal service from them all. They wished him every success.

In reply, Mr. Russell said he was very much obliged, but he did not want their thanks now. Let them wait to the end of the session, during which he would give of his very best, and then, if they appreciated what he had done, he would be very grateful for their thanks.

Conveying Metal from the Cupola.

The meeting was then thrown open for a general discussion of the conveying of molten metal from the cupola.

Mr. W. T. Evans, the retiring President, who opened the discussion, said there could be no doubt much of the success of a casting depended on getting the metal as quickly as possible from the cupola to the mould, so as to leave as little opportunity as possible for metal to cool. The method of conveyance must be as rapid as possible. There was no object in melting a metal at the correct heat and then allowing that heat to be dissipated through slow methods of distribution. A great factor was to avoid as much manual labour as possible and to obviate all unnecessary handling of iron. Many plants made a special feature in the conveyance of metal from the cupola by means of overhead runways, and he felt sure they had a future before them in the foundry world, especially in the case of light castings. One of the advantages was that the floor space was increased and kept free, and another was the ease in which ladles could be moved in any direction.

Three factors were operating—position, time and temperature, for unless the first is suitable, and unless the metal can be poured at the correct speed and temperature, trouble is certain to result. There were no difficulties with electric cranes, which had distinct advantages over the obsolete and laborious methods of shifting heavy ladles. They must be so arranged that the man has complete control over the stream of metal, but in regard to control, he thought there was some room for improvement. There was also the need to adopt, as could be done, a very simple combined steering device and shield to keep the heat of the metal from the man's face when casting.

With respect to shanks, there was room for improvement in the handles, and double handles with swivel joints at one end had a distinct advantage. A point to be noted was a method of tilting the spout in the cupola to enable them to keep a stream of metal continually ready. The spout could be tilted to run the metal into the opposite ladle.

An Existing Problem.

Mr. Russell said they had been shown some ideas and he would remind them that what to some might be everyday practice is not always known to all the other members, and they could learn a lot from one another on this question. It was an important question, for the success of castings so often depended on getting the metal quickly to the mould, and unless the metal arrived there very hot, it was almost hopeless.

They had two distinct methods of handling in their own works, and they could not make up their minds which was the better. The problem was they had two distinct foundries, each self-contained units; yet they found it was not always convenient or economical to melt in both foundries, because one might be short of work or work was running light, and one had not sufficient weight of metal to justify two cupolas for the day's work on the floors. They also had the added disadvantage that the premises were very old, and they could not get a clear straight run as in a modern foundry, where they might be making only one kind of casting, using special runways for feeding purposes. The problem was that on one side was a newer part served by 12-ton electric cranes, where they could handle metal quite well and distribute it in ton quantities; at the other end of the foundry, which was old and built in three distinct stages, the available cranes ran across the shops. They decided to put up a runway in what was known as the old foundry, with a capacity of 10 cwt. These started in front of the cupolas and passed through the foundry under the cranes across an open yard, and into the new foundry. Normally, in this foundry, where it is all small work, a 5-cwt. capacity ladle of the double-handed type is used. This could be moved along by pushing, but some drawing was also necessary.

Runway Considerations.

Loughborough was interested in the distribution of metal by overhead tracks, and he would point out it was a disadvantage to have two men to keep full and proper control. Before installing any runway it is necessary to consider whether the track will limit the use of any crane whose path it crosses. The level of the floor must be studied, so that when a ladle is set under the cupola spout no further adjustment is necessary. They had the disadvantage of the doors on crossing the open space, for these were closed in winter.

Tramway Installations.

The other system introduced was the tramway, because the roof would not stand a runway, and they did not care to put up a special scaffolding. They laid a 2-ft. tramway track filled inside the rails with concrete, making a good level path, which was easily swept and kept clear. This ran the full length of the shop about 12 ft. from the side wall. This was one of the factors they had to consider. It seemed to them, if they put up a track close to the cupola, they would waste a lot of valuable room as clearance by the side of the wall. They thought they could use the floor space more economically, and the total waste of floor space by their method was that just clear of the tracks. A branch line served by a turntable was placed opposite each cupola. The lines are also used for handling facing sand and castings.

They used a 6-cwt. ladle mounted on a specially-constructed truck, which enabled metal to be poured out on either side. Arrangements were made to prevent skidding or slipping sideways when pouring. They also found it an advantage to introduce a safety catch of their own design to prevent the shank tipping over when quite full. It was liable to swing over when no lock was fitted, but they could lock upright and there was no risk. This ladle approaches the cupola spout from the front, and this is one of the great difficulties, for the ladle approaches sideways and cannot be moved in relation to the width of the spout. He had found with the track system it is more difficult than with shank hanging or swinging in front of the spout. He found one man could easily control the truck and experience very

little difficulty other than those mentioned. The cupola spout has to be higher than usual to leave room for the truck to be pushed underneath. Splashes of metal were liable to get into the bearings of the trucks, until a special shield was made to overcome the difficulty. They also had to fit a splash guard to keep shots of metal from the tipping device. These tended to make the ladle jump as it was being tilted over to get the necessary pouring effect, but by putting up an adequate guard on the front of the shank this was prevented.

A turntable was a source of trouble unless cleaned out; the sand tended to clog the rails unless they were well set up with a good clearance underneath.

MR. RUSSELL asked if anyone had experience of two distinct tracks on higher levels, for the risk was greater with metal high up in the air. Was there any system whereby a simple variation could be used to save a multitude of tracks converging over one point?

Requirements in Runway Operations.

MR. H. H. MOORE said the system given was not a good one, but probably the roof conditions or existing cranes had brought about the poor conditions. As to the advantages of runways in general, he would not say anything then, as he was personally interested. But, taking the case in point, it was a pity to waste the space against the cranes. Runways need not necessarily be run on a fixed track. Runways can be made part of the cranes by linking them up automatically. Curves should be avoided, for turntables are available which are more steady than those on the ground. The doors could be opened and closed automatically by an electrical connection operating a catch from the runway track—really quite a very simple device. A combination of jib cranes with overhead tracks is very useful. The use of battery trucks had been overlooked wherever electric current is available. The battery truck has very great possibilities in a foundry. A firm floor was needed, of course. He thought they would be used in foundries very largely in the very near future.

Double Spouts.

MR. H. BUNTING referred to the advantages of having two spouts to the cupola. The important factor was to get the metal away as quickly as possible, and where one was working both heavy and light work, it was a difficult matter at times to fill both sizes of ladles on account of the heights. With a second spout on the opposite side of the cupola it is an easy matter to teem into the shank and keep the cupola working, whereas in the other case it was often found that it is necessary to stop the blower to get ladles back, and the difficulties which exist of getting shanks under one side are obvious. He was rather surprised that in some of the modern shops there was still that difficulty, whereas if the cupola was put down with double spouts it would obviate many difficulties, facilitate the melting process, and aid the getting away of the metal more quickly. They were using both kinds, including the double-handed shank, and one could elaborate on the advantages and disadvantages of both of them. Over rough ground the double-handed is better, but for actual casting the single-handed is to be preferred.

MR. J. LUCAS said it was time the Institute took care of the younger men, for he was certain they could derive much benefit if they could be induced to attend the lectures. With regard to double-handed ladles, very little was said about weight. It was generally found that with a double-handed ladle two men carrying a shank weighing 2 cwt. is about as much as two men can manage. In regard to swivel ends, one found that at times there was a tendency to lock. He had found it best to use 1-cwt. shanks, having one double hand and one single hand. Nothing had been said about the method in America of conveying moulds to the cupolas; possibly we have not reached that stage. It would be interesting to hear if anyone has seen the operation in practice. Was there any method of keeping ladles clean?

Vote of Thanks.

MR. LUCAS then moved a vote of thanks to the President and Mr. Evans, and said such discussions did good, for sometimes they went away feeling that the papers were rather above them.

MR. A. S. CLARKE (Loughborough), in seconding, said they had had a subject which, whether practical foundrymen or not, they could follow intelligently.

MR. W. STREET supported, and in reply the PRESIDENT said he was following Mr. Evans, who was always ready to help another, and personally he desired to give public thanks for all he had done for him personally.

MR. EVANS said he was pleased to have interested the members. The foundry had been looked down upon as anyone's job, but they found it different now, and managers of works were getting more interested in the foundry, and saw it was really a scientific business. He was quite in favour of a junior section in order to get the apprentices more interested. There was the feeling that if a sharp boy got interested in foundry work and stayed on he was likely to lose caste. The foundry was more or less laborious, and so must be made interesting. He hoped they would be able some day to hear a paper from Mr. Moore on runways, for there were many parts, as had been shown that night, where they could improve. As regards battery trucks, they had had them for years, and he did not know what his shops would do without them. They were coming more and more to the front in foundries, and in his place the trucks removed hundreds of tons of scrap weekly, and were invaluable.

MR. MOORE stated he would be pleased some time to give a paper on runways, and the President agreed this would be very acceptable.

Book Review.

"NICKEL ORES." By W. G. Rumbold. Published under the direction of the Mineral Resources Committee of the Imperial Institute by Mr. John Murray. (Price 5s.)

This book is one of the series of monographs on mineral resources which have special reference to the British Empire.

Although nickel was discovered 172 years ago, it was only sparingly used until the last quarter of the nineteenth century, during which period the New Caledonian (1874) and Sudbury (1885) deposits were first mined.

The metal is largely used in the production of nickel steel, either alone or with other metals. It also forms useful alloys with copper, manganese and chromium, with copper and zinc ("nickel-silver"), and with copper and aluminium. It is also used in electroplating, in coinage, in the manufacture of certain small articles, as an anode in storage batteries, in wire, sheet and gauze form for certain appliances, as a catalyst, and as oxide in the manufacture of glass.

The world's production of nickel (metal) in the years immediately preceding the Great War averaged about 30,000 tons per annum. During the war period it rose to upwards of 40,000 tons. There has been a considerable drop in production since 1918, and a gradual drop in price since 1920.

The first chapter of the monograph deals briefly with nickel minerals; the mining, concentration and reduction of the same; and the properties, uses, prices and world's production of the metal.

In the second chapter the deposits of the British Empire are described, the principal being Sudbury and Cobalt, Ontario. Other occurrences described are those of Manitoba and Quebec, New South Wales, Tasmania, New Zealand, Cape Province, and Transvaal.

The third and last chapter describes the nickel deposits of foreign countries, principally those of New Caledonia, Germany, Greece, Norway, Sweden, and United States. Nickel, like rubber, is a material for which the States is dependent on the British Empire.

A map shows the chief nickel occurrences in the world, and the volume concludes with a list of publications on nickel.

D. TOMLINSON & SONS, machinery and metal merchants, have removed to 32, Upper Union Street, Hull.

Foundry Work in South Africa.

The many British foundrymen who have met Mr. F. W. Hobbs, of the Standard Brass Foundry of Benoni, Transvaal, have been amazed to learn of the potentialities of South Africa as a foundry centre, providing they are prepared to work hard and to adapt themselves to existing conditions. Mr. Hobbs has spent some four months in Great Britain and Paris, where he took part in the International Congress. His foundry is situated on the best part of the Rand, and his chief business is the supplying of replace parts for the mining machinery. He is credited with having turned out the largest bronze casting in South Africa. One of the objects of his visit, apart from the buying of various plant, was the gaining of some knowledge of the manufacture of steel

Photo by] *[Maull & Fox.*

Mr. F. W. Hobbs.

castings. Obviously many difficulties surround this proposition, as the plant must be elastic, and the refractories, both for furnace construction and for moulding sands, are at present unknown quantities. Cheap electricity and steel scrap are available, whilst coke, oil and pig are dear. Mr. Hobbs will appreciate any help the Mother Country can give to solve his problem.

Before sailing last Thursday he requested us to convey his sincere thanks to the many firms who afforded him facilities for the inspection of their plant, especially Messrs. Vickers, Limited, J. Stone & Company, Edgar Allen & Company, John Andrews & Company, The Midland Motor Cylinder Company, and the Phosphor Bronze Company.

During his stay in Europe Mr. Hobbs was made a member of the Institute of British Foundrymen, and is the first member from the South African colony.

Duty-Free Iron and Steel Imports into Japan.—For the present, under an Imperial ordinance, galvanised sheets and a number of other iron and steel products are exempt from import duty into Japan, effective until March, 31, 1924. In addition to a number of other commodities, the ordinance exempts from import duty, bars or rods, including tees, angles, etc.; wire rods in coils; plates and sheets not coated with metals, nor exceeding 0.7 mm. in thickness, or not otherwise mentioned in the tariff law; plates or sheets, tinned or galvanised; wire; pipes and tubes, not otherwise provided for in the tariff; nails, screws, bolts, nuts, washers and rivets; railroad construction material; posts and other materials for suspending electric lines; materials for construction of buildings, bridges, docks, etc. (shipbuilding materials excepted).

Book Reviews.

The British Acetylene & Welding Handbook. Published by the "Acetylene & Welding Journal," 30, Red Lion Square, Holborn, London, W.C.1. Price 7s. 6d. net.

This book has been prepared by a Committee of the British Aceylene & Welding Association, who are to be congratulated on having placed such a fund of useful information before the engineering and metallurgical world.

Apparently there are several technical welding Societies, but representing metallurgical interests, and realising that the same metallurgical principles underlie all welding processes, we suggest that one really national organisation would better serve both themselves and the industry they cater for. Thus, too, this book would be still more useful if data for electric welding were included.

The book is divided into ten sections, but that first scanned by foundrymen will be that devoted to cast-iron welding. The essentials underlying the process are well set out, but the repetition of the fact that any weld is better than the adjacent metal does not impress us, because the very operation of welding often communicates to the latter a very undesirable heat treatment. The use of manganese bronze for welding cast iron is distinctly interesting, and one on which foundrymen would welcome more information. We were pleased to see the necessity for a thorough heat treatment after welding being emphasised. In any handbook, such sections as this require modification from time to time as experience accumulates, but the data and constants contained on pages 123 to 128 will constitute a ready reference for a considerable period.

Report of the Committee of the Privy Council for Scientific and Industrial Research for 1922-3. Published by His Majesty's Stationery Office, Imperial House, Kingsway, W.C.2.. Price 4s. 2d., post free.

Reading between the lines, one cannot help but gain the impression that the various research organisations must be made to realise that the Government £ for £ grant will not continue indefinitely, and that they must place themselves in a self-supporting position after the five years has expired. The British Cast Iron Research Association has completed two years, and during this period has received from the Department £5,000. If this Association progresses at the present rate some £30,000 should be spent during the quinquennial period, and should produce something really worth while for the industry.

Publications Received.

Journal of Scientific Instruments. Published monthly by the Institute of Physics, 10, Essex Street, Strand, London, W.C.2. Price 2s. 6d. net.

The first issue of this journal contains 32 pages of highly technical matter. It is edited by Dr. John S. Anderson, M.A., D.Sc., Ph.D., of the National Physical Laboratory, and Sir R. T. Glazebrook, K.C.B., F.R.S., is chairman of a very highly scientific editorial board, which includes no less than eleven Fellows of the Royal Society. There is a distinct scope for such a journal, providing it receives the whole-hearted support, which it deserves, from the scientific world generally.

Foundry Equipment.—The Pneulec Machine Company, Limited, are sending to the various foundries a very handsome folder for the purpose of filing the various leaflets which are sent out periodically. The "Pneulec News" for October is distinctly novel, and strikes a new note in the foundry equipment business.

The Monometer Manufacturing Company (1918), Limited, of Savoy House, 115-116, Strand, London, W.C.2, announce that as a result of the recent Olympia Exhibition they are installing furnace plant at the works of Messrs. Harland & Wolff, Limited; Haddon-Caxton Type Foundry Company; Gamons, Limited; Siemens Bros., Limited; Fullers Electric Company; and London and Norwich Press. Additionally a brass-melting furnace was ordered for Switzerland and a die-casting machine for Kent.

New Catalogues, etc.

Hematite Pig-Iron.—The October stock list of pig-iron has reached us from the Consett Iron Company, Limited, of Consett, Co. Durham. It sets out the analyses of a useful range of hematite irons. A second leaflet outlines a number of really high silicon hematites, ranging from 3.5 to 9 per cent. silicon.

Welding Rods.—In sending us their new catalogue entitled, "Welding Cast Iron," the Suffolk Foundry (1920), Limited, of Stowmarket, refer to our leader of August 23, and point out that they have been making this speciality for 10 years, adding that they have not found it necessary to have the rods coated with carbon. They do, of course, incorporate a high silicon content, and if the weld is not conducted under violently oxidising conditions, there may be no need to add carbon. We are pleased to see that the necessity for heat treatment is emphasised.

Refractory Materials.—We have received from Messrs. Thomas E. Gray & Company, Limited, of 119, High Holborn, London, W.C.2, a booklet descriptive of "Silacene," a plastic refractory material. The material is stated to consist of silica and alumina, and to possess a melting point of 1,850 deg. C. A special point is made of the fineness of the grain, which mathematically exposes less surface to the action of a flame or slag than a coarser material. If rapid chemical action is required, the chemist invariably exposes a maximum of surface. It seems reasonable to suppose, therefore, that the fineness of surface exposed to chemical action is of great importance.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A New Name for Semi-Steel—Steel-Mix Iron.

To the Editor of the Foundry Trades Journal.

Sir,—With reference to the current discussion regarding the name "semi-steel," it will doubtless be of interest to learn that ourselves and other consulting chemists have for some time used "steel-mix iron" as an alternative when referring to the material. The percentage of steel used is prefixed by a qualifying percentage (*e.g.*, 10 per cent. steel-mix iron), and we find that misconstruction is avoided. Trusting that this, or similar name, will be universally adopted.—Yours, etc.,

Beecroft & Partners, Limited,
C. J. Stokes,
Director.

St. Peter's Close, Sheffield.
October 12.

Iron and Steel Output in September.

The National Federation of Iron and Steel Manufacturers report that the production of pig-iron in September amounted to 558,600 tons, compared with 599,800 tons in August and 430,300 tons in September, 1922. The September output included 165,200 tons of hematite, 182,600 tons of basic, 151,100 tons of foundry, and 24,000 tons of forge pig-iron. The output of steel ingots and castings amounted to 695,100 tons, compared with 567,500 tons in August and 555,900 tons in September, 1922.

French Iron and Steel Output in August.

On September 1 last 109 furnaces were in blast in France, or two more than on July 31. The output of pig-iron in August totalled 486,250 tons (compared with 436,420 tons in July), including 28,107 tons of forge iron, 97,310 tons of foundry iron, 4,081 tons of Bessemer iron, 342,136 tons of basic iron, and 14,636 tons of special pig-iron.

The steel output during August totalled 452,364 tons (as compared with 399,528 tons in July), of which 441,816 tons were ingot steel and 10,548 tons castings. The output includes 5,512 tons of acid Bessemer, 279,707 tons of basic Bessemer, 162,638 tons of open-steel, 1,056 tons of crucible, and 3,451 tons of steel.

Trade Talk.

The date and venue of the International Foundry Trades Exhibition, 1924, are now being considered, and with a view to ascertaining the opinions of the industry it is proposed to hold a luncheon and meeting on Thursday, October 25, at the Birmingham Chamber of Commerce. Mr. H. Lakin-Smith is the chairman of the Exhibition Committee.

T. F. Clarke & Company, iron and steel merchants and agents, have removed to 12, Lime Street, London, E.C.3.

The Sideron Steel Company, Limited, have removed to Dominion House, Fenchurch Street, London, E.C.3.

The Whitehaven Hematite Iron and Steel Company, Limited, have decided to restart one of their furnaces at Cleator Moor.

William Wardle & Company, tinplate and metal merchants, of 9, Cook Street, Liverpool, have removed to 3, Rumford Place, Liverpool.

The Leeds Forge Company, Limited, have received an order from the New South Wales Government for the supply of fifty steel coaches.

P. H. Muntz & Company, Limited, have removed from 11, Fenchurch Street, to 229, Gresham House, Old Broad Street, London, E.C.2.

E. W. Neems & Company, metal merchants, have removed from 11, Fenchurch Street, to 229, Gresham House, Old Broad Street, London, E.C.2.

At a meeting of the Sheffield Foundry Trades Technical Society, a lecture on "How to Read Drawings and Blue Prints" was given by Mr. S. Brewin. Dr. P. Longmuir presided.

Mr. J. W. Fowler, hitherto with T. Bashforth & Company, Union Foundry, Doncaster, has established himself in business as an iron and brass founder at Riverside Works, Cherry Lane, Doncaster.

The proposed erection at Stafford of new works for the Poldi Steel Company (England), Limited, 156, Caledonian Road, London, N.1, is stated to have been abandoned, and a new site is now being sought.

Sir W. G. Armstrong, Whitworth & Company, Limited, have secured a contract from W. V. Bowater & Sons, Limited, for the erection of a new paper mill, with buildings and machinery, at Northfleet, Kent.

A paper on Clyde marine oil engines was read on October 4 by Professor Mellanby at a meeting of the Glasgow Branch of the Institution of Mechanical Engineers held in the Royal Technical College. Mr. J. T. Ewen presided.

Mann's Patent Steam Cart & Wagon Company, Limited, have booked stand No. 43 at the Commercial Motor Exhibition at Olympia, from November 22 to December 1. The company are making a special feature of their Gully emptying machine.

At the meeting of the Sheffield Association of Metallurgists and Metallurgical Chemists, recently, Mr. G. Batty gave an interesting address, taking for his subject "Notes from a Steel Maker's Log." Mr. Bernard W. Methley (Rotherham) presided.

The winter session of the North-East Coast (local section) of the Institute of Metals was commenced in Armstrong College, Newcastle, on October 9, when Professor Louis, who has succeeded Sir Charles Parsons in the presidency of the section, gave his opening address.

The members of the Yorkshire Branch of the Institution of Mechanical Engineers held a meeting at the Brown-Firth Research Laboratories, Sheffield, when a paper on "Modern Developments in Steam Raising and Crane Construction," by Sir James Kemnal, was presented. Mr. F. Clements, of Parkgate, presided.

The ascertainment issued by the Cleveland Ironmasters' Association certifies that the average net selling price of No. 3 Cleveland pig-iron for the past quarter was 99s. 7.72d. per ton, as compared with 112s. 1.64d. per ton for the previous quarter, a drop of 12s. 5.92d. per ton. In accordance with the sliding scale arrangement, there will be a reduction in the wages of blast furnacemen of 12.50 per cent., which will bring them down to 38 per cent. above the standard.

The Belfast shipbuilding output for the nine months ended September 30 totalled eight steamers, aggregating 102,000 tons, compared with 86,943 tons for the corresponding period of last year. Four new vessels, which were launched before January 1, have been completed, and two vessels aggregating 40,000 tons have been reconditioned. Comparatively few new orders have been booked, the most important being the two 21,000-ton motor vessels for the Royal Mail Steam Packet Company now under construction at the new yard of Harland & Wolff. Workman, Clark & Company have secured the contracts for two cargo boats for the Court Line (of London), and Harland & Wolff that for a passenger vessel for the Belfast Steamship Company.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The slight improvement noted in conditions of the Cleveland iron trade last week has been fairly well maintained, and with values now established on something like stabilised levels buyers are coming forward with more freedom than has lately been observed, while inquiries for export are more frequent. As an indication of the trend of the market in the latter class of business it may be noted that the shipments of pig-iron from the port of Middlesbrough during October up to and including the 9th inst. amounted to 7,170 tons, as against 4,269 tons on September 10. Another hopeful feature in the present outlook is the fact that the long-continued fall in values has been checked, and although at the moment prices must still be regarded as on the weak side, indications would seem to point to the probability of an early upward tendency. At this week's market makers continued to quote 96s. for No. 3 G.M.B., but it was possible to shade this figure for reasonably substantial parcels. Other prices were unchanged, No. 1 standing at 102s. 6d., No. 4 foundry 91s., and No. 4 forge around 88s. 6d. per ton.

In the Tees-side market, stimulated by the recent improvement in demand, hematite values have continued steady for several weeks past. There is now undoubtedly more business passing in the home trade, and were the boilermakers' strike settled and shipbuilding activity resumed, the volume of trade would unquestionably expand. The export outlook is, also, more encouraging. There is a better inquiry, and Italian buyers are more in evidence. On the whole, therefore, while the level of prices remains pretty constant, there is a tendency to greater firmness. East Coast mixed numbers being generally quoted at 99s., with the No. 1 quality about 100s. per ton. Similar conditions may be said to obtain in the hematite industry in West Cumberland and North Lancashire, prices continuing steady, Bessemer mixed numbers being quoted at 110s. per ton delivered at Glasgow and Sheffield, and 115s. per ton at Birmingham.

MANCHESTER.—In this market buying by pig-iron consumers is still of a perfunctory character, slackness in the foundry industry being responsible for the limited demand, while forward business is exceptionally quiet for the period of the year. The idea of buying over the next three months on the theory that prices of pig-iron could not fall has weakened now that some of the sellers of furnace coke in the Midlands have quoted 2s. per ton less than the price fixed a short time ago. Consequently there is not much Derbyshire iron being offered even on a basis of 90s., and as a general rule the consumer has to pay 91s. basis for any small lots that he is compelled to buy. The ordinary price quoted for Northamptonshire foundry iron is 90s. on trucks, but of course this is now of no interest to the Manchester ironfounder, because of the much higher carriage.

THE MIDLANDS.—The quarterly meeting at Birmingham last week disclosed little change in the pig-iron section of the trade, the volume of business offering being regarded as disappointing in the face of the recent reduction in fuel prices, which, however, makers contend has already been discounted. The market for foundry iron was, however, a shade better than that for forge, but there was nothing really encouraging about it, nor is there likely to be while the general trade of the country remains so poor, and there is so much unemployment. The quotations for this grade of iron were none too strong, as follows:—Northamptonshire forge, 81s. to 82s.; No. 3 foundry, 90s.; Derbyshire forge, 84s.; No. 3 foundry, 90s.; all net, f.o.t. furnaces.

SCOTLAND.—The outlook from a market point of view can hardly be termed satisfactory, there having been less business put through than during the previous week, and the price of No. 3 foundry is a trifle easier at 99s. at the furnaces. The Ruhr position is being carefully watched, for if the German mines and coke ovens are at once restarted, which is very doubtful, it is going to create a change in the fuel position here, and will also tend to cheapen costs on the Continent, while we may see a renewal of competition in pig-iron, etc., from that quarter.

Finished Iron.

In this branch of the iron trade, with the exception of makers of marked bars, who have sufficient work in hand to keep them steadily employed, the outlook is still far from encouraging, and many manufacturing firms are still partially, if not entirely, idle. Prices on the whole, however, are fairly well maintained at previous quotations, no outstanding changes having been marked in crown or inferior quality bars, for which the demand continues slack. Less foreign competition is reported in commoner qualities of bars, while there is very little call for gas strip. Some of the firms who roll both iron and steel strip have the former mills idle, and the latter fairly well occupied. Probably the problem of costs is more urgent in connection with iron strip than any other form of manufactured iron owing to this competition.

Steel.

Reports from representative firms in the Sheffield steel industry indicate some improvement in inquiries for semi-products as far as concerns acid billets, but other qualities seem in indifferent demand. At the same time makers are not inclined to make price concessions, which suggests that rock bottom has been reached. A good deal of open-hearth steel is being made and disposed of, but the call for crucible steel has again sagged somewhat. Very little is doing in electric steel, and it is reported that less than ten of the furnaces, numbering about fifty in this district, are now operating. A fair volume of business in railway steel is coming forward. There is a certain amount of inquiry from abroad for various alloys, and in some directions home demand is satisfactory. This latter, however, is rather patchy, some districts, carrying on the manufacture of iron and steel, being much busier than others, if the demand for alloys is any criterion, but taken, as a whole, the situation leaves much to be desired. Business in tinplates continues satisfactory. There is a good deal of inquiry, and a very fair proportion of orders is coming along, all at the official minimum prices. For the standard sizes quotations for coke finish are as follows:—IC 14 by 20, 112 sheets, 108 lbs., 23s. 1½d. per box; IC 28 by 20, 112 sheets, 216 lbs., 46s. 3d. per box; IC 28 by 20, 56 sheets, 108 lbs., 23s. 7½d. per box, with lights at ¾d. per lb. reduction, net cash, f.o.b. Bristol Channel ports.

Scrap.

Reports from the various centres for the distribution of this class of raw material favour, on the whole, a somewhat stronger tendency in certain directions, although the demand for foundry scrap continues generally quiet. As far as Lancashire consumers are concerned in this connection the explanation is that the iron foundries all through the district are short of work and do not want to buy at any price. So soon as the demand for castings revives there should be a sharp upward movement in cast scrap, for it is certain that when the foundries do obtain work they will not consent to pay 20s. or 25s. per ton more for foundry pig-iron than for good scrap. Hence there is probably a chance for higher prices in this department of the scrap market, for it is unlikely that pig-iron will fall more than about 10s. per ton for a long time. With Scottish foundrymen the demand for cast-iron scrap is still fairly strong, and stocks are very limited. Heavy machinery metal is difficult to secure, and the same applies to scrap railway chairs, while it is doubtful if buyers could purchase at under 92s. 6d. to 95s. Ordinary cast-iron scrap, which is in demand for both the iron and steel works, remains firm at about 85s. Light cast-iron scrap and furnace firebars are quoted at 67s. 6d.

Metals.

Copper.—Conditions in the standard market of late have developed consistent weakness, prices having sagged to a £60 level; values are now some 90s. below the best price a month ago. While a fair business continues both in this country and France, the direct source of weakness comes from the United States, where domestic consumers do not appear to have any confidence in the recuperative powers of the market. Hopes are, however, expressed that consumption will expand materially should the market become more steady around present levels, and in this way the surplus production might easily be disposed of without the fear of increasing stocks materialising. Current quotations:—*Cash*: Thursday, £60 5s.; Friday, £60 2s. 6d.; Monday, £60 12s. 6d.; Tuesday, £60 12s. 6d.; Wednesday, £60 17s. 6d. *Three Months*: Thursday, £61; Friday, £60 17s. 6d.; Monday, £61 7s. 6d.; Tuesday, £61 7s. 6d.; Wednesday, £61 12s. 6d.

Tin.—Movements in this section of the market, though active on the whole, have been occasionally irregular, fluctuations at times covering a somewhat

wide margin of values. There has been evidence, however, of a renewed expansion in the general trade demand, which has been the chief dominating factor, and the outlook as regards the world's consumption is viewed in an optimistic light. Home stocks having been further considerably reduced during September, tin in near positions was more difficult to buy, and the squeeze resulted in the backwardation on forward delivery, which had recently entirely disappeared, being increased to as much as £2 a ton. This certainly testifies to the strong control exercised over the limited stocks available. America again took large lines on this side and from the East, while the bulk of the Straits shipments goes to the United States. Current quotations :—*Cash* : Thursday, £201 10s. ; Friday, £201 5s. ; Monday, £202 7s. 6d. ; Tuesday, £202 17s. 6d. ; Wednesday, £201 15s. ; Thursday. £199 ; Friday, £199 5s. ; Monday, £200 7s. 6d. ; Tuesday, £199 17s. 6d. ; Wednesday, £200 10s.

Spelter.—The market for this metal has undergone little change during the past week, the easier tendency noted being doubtless due to a weakening of demand by the galvanising industry. The producing side shows practically no alteration ; Belgian, German, and English works refrain from offering, and America continues to be above our parity. Current quotations :—*Ordinary* : Thursday, £32 ; Friday, £31 17s. 6d. ; Monday, £32 7s. 6d. ; Tuesday, £32 18s. 9d. ; Wednesday, £33 10s.

Lead.—Business in soft foreign pig has continued steady, with values well maintained, indicating a firmer tendency. The official returns of the London stocks on October 1 showed a small decrease of 1,439 tons as against a month previous, but there seems to be plenty of soft foreign lead held in private warehouses or nursed by dealers, so that there can be no question of any scarcity. Current quotations :—*Soft foreign (prompt)* : Thursday, £26 7s. 6d. ; Friday, £26 10s. ; Monday, £27 ; Tuesday, £27 7s. 6d. ; Wednesday, £27 10s.

Company News.

Dominion Steel Corporation, Limited.—Dividend, 1½ per cent. on preference.

Stanton Ironworks Company, Limited.—Interim preference dividend, 6 per cent. per annum.

Hestovox, Limited, 32, Palmerston Road, Acton, London, W.—Capital £5,000 in £1 shares. Engineers.

Cleveland Forge Company, Limited, Bagillt Engineering Works, Bagillt, Flint.—Capital £5,000 in £1 shares.

Cardiff Ironworks Company, Limited.—Capital £5,000 in £1 shares. Solicitor: R. W. Nicholas, 84, Queen Street, Cardiff.

H.B. (Engineers), Limited, 6, The Parade, Aldersbrook Road, London, E.12.—Capital £250. Directors: Messrs. H. & T. Hutchings.

Manor Bridge Iron Company, Limited, Manor Lane, Halesowen.—Capital £7,000. Permanent directors: B. Marsland and H. L. Wright.

Yates & Thom, Limited.—Ordinary dividend, 7½ per cent. actual for year; brought forward, £15,007; reserve, £10,000; carried forward, £22,960.

Veemar Steels, Limited, Trinity Square, Tower Hill, London, E.C.—Capital £100. Directors: M. Wormer, V. D. Drury and D. D. Drury (secretary).

Percival Metal Smelters, Limited, Percival House, Percival Street, London, E.C.—Capital £3,000. Directors: C. May, F. W. Marter and F. Rixon.

Ferranti, Limited.—Net profits, £36,362; brought forward, £24,482; ordinary dividend, 10 per cent., free of tax; reserve, £20,161; carry forward, £25,162.

Tinsley Rolling Mills Company, Limited.—Profit, including amount brought forward, £5,124; preference dividend, £2,100; credit balance, £3,024, carried forward.

Cosgrave & Company, Limited, 174, Pearse Street (formerly Great Brunswick Street, Dublin).—Capital £13,000. Iron and metal founders, engineers, etc. Director: R. R. Cosgrave.

Peranne & Company, Limited.—Capital £2,500 in £1 shares. Engineers. Directors: J. B. A. E. Peranne, 1, Belmont Street, London, N.W.1.; H. C. Picton-Jones and Eugene Amette.

Robert Rigby, Limited, New John Street Metal Works, Birmingham.—Capital £30,000 in £1 shares (10,000 6 per cent. cumulative preference). Non-ferrous metal manufacturers.

South Yorkshire Steel Company, Limited, Norris Deakin Buildings, King Street, Sheffield.—Capital £2,000 in £1 shares. Directors: J. H. Charlesworth, A. F. Bone and S. Burridge.

Glenboig Union Fire-Clay Company, Limited.—Net profit, including £11,979 brought forward, £32,968; dividend, 20 per cent., less tax, £22,812; repairs and renewals, £13,677; carry fo ward, £10,155.

Personal.

Councillor Stanley Sadler, J.P., who has been re-elected mayor of Middlesbrough, is a director of the firm of Sadler & Company, Limited, founded by his father, the late Sir Samuel A. Sadler.

Mr. John Barr, who has just retired from the post of commercial manager of the Vickers' Shipyard, Barrow, after 49 years' service, has been the recipient of a presentation from the officials and men.

Mr. Roland Woods, who for many years has been assistant secretary to the National Federation of Iron and Steel Manufacturers, has been appointed to a position with the Swansea and District Freighters' Association.

Wills.

Preston, E. J., for many years a director of J. Stone & Company, Limited, engineers, Deptford, S.E. £231,273

Laing Warrington, of Old Court Mansions, Kensington, and Fenchurch Street, E.C., Chairman of Yuills, Limited £39,985

Gardiner, T. C., of Essendene, Clifton, Bristol, chairman of Gardiner, Sons, & Company, Limited, constructional engineers, etc., Bristol £38,239

Brougham, J. R., of Buckland House, Lymington, Hants, for some years manager of the Broad Street, Birmingham, branch of Guest, Keen & Nettlefolds, Limited £15,065

Gazette.

Trading in the style of the Antique Copper Curb Company, Messrs. S. S. Budd and W. T. Bailey, Prospect Works, Sneyd Street, Cobridge, antique copper curb manufacturers, have dissolved partnership. Debts by Mr. S. S. Budd, who continues the business.

Trading in the style of Bree, Laidlaw & Company, Messrs. R. D. Bree, P. Bree, and W. Laidlaw, Steanard Lane, Mirfield, engineers, have dissolved partnership.

Brown (Donald) & Company, Limited, Newcastle-on-Tyne, ironfounders, in liquidation. Mr. R. H. Newton, 90, Pilgrim Street, Newcastle-on-Tyne, has been appointed receiver.

G. H. Neal & Company, Limited, London, W.C., engineers, in liquidation. Mr. F. Wilcock, 1, Great Winchester Street, E.C., C.A., has been appointed receiver.

Wolfe Keene Engineering Company, Limited (late Luby-Lowe Engineering Company, Limited), Bristol, in liquidation. Mr. A. Collins, 28, Baldwin Street, Bristol, C.A., has been appointed receiver.

A receiving order has been issued in the case of A. T. Pryce, 92 Lightwoods Hill, Warley, late trading as a brassfounder at Empire Works, Holliday Street, Birmingham, as A. T. Pryce & Company.

A. J. Clemmons, Ingleside, 134, Alcester Road, South Kings Heath, aluminium manufacturer, trading as Midland Aluminium, 42, Great Francis Street, Birmingham, has been adjudicated bankrupt.

Contracts Open.

Stafford, October 20.—100 tons of 6-in. diameter cast-iron pipes and specials, for the Corporation. Mr. W. Plant, borough and waterworks engineers, Borough Hall.

Chesterfield.—Six-inch cast-iron pipes, approximately 73 tons, for the Chesterfield Rural District Council. Mr. G. Frith, Rural District Council Offices, Chesterfield.

Congleton.—Supply, laying and jointing about 392 yards of 6-in. and 4,907 yards of 4-in. water mains, with all necessary valves, etc., for the Buglawton Urban District Council. Mr. C. Russell-Hall, engineer, Chapel Street, Congleton, Cheshire.

Fowey, October 22.—Provision and laying of about one and a-half miles of 6-in., 5-in., and 3-in. diameter cast-iron pipes and steel tubes, for the Fowey Town Council. Mr. J. D. Haworth, Alliance House, 15, Dartmouth Street, Westminster, S.W.1. (Fee, £3 3s., returnable.)

Propaganda Meeting at Wigan.—In connection with the Lancashire branch of the Institute of British Foundrymen, it is proposed to hold a meeting in the Mining and Technical College, Wigan, on the evening of Saturday, October 27. At this meeting a lecture will be given by Mr. S. G. Smith, of Manchester, on "The Manufacture and Characteristics of Cast Iron," and a short account of the work of the Institute will also be given.